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FIRE CONTROL NOTES

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A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 7 Number 1

234771

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire-fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. The periodical is printed with the approval of the Bureau of the Budget as required by Rule 42 of the Joint Committee on Printing.

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WE RESUME

Division of Fire Control, Washington Office, U. S. Forest Service

After nearly 4 years of wartime suspension, FIRE CONTROL NOTES gets back into circulation and will be published quarterly, fulfilling its mission, we hope, even more successfully than before.

About a year ago a special effort was made to resume publication, but the wartime limitations then placed upon the form and content of the periodical would have so changed its character that we decided to wait until better times. Under those limitations, we would have been required to confine the contents to the single subject of fire-control equipment.

Now with a clear green light, we can move ahead with a periodical substantially the same as prewar issues and cover the entire field of fire control with the breadth of expression and subject matter set forth in the text of the flyleaf immediately preceding this article. That statement will, as in the past, express our editorial policy. FIRE CONTROL NOTES will be distributed to a mailing list of about 4,000.

The contents of this first postwar issue have not the diversity we or the readers desire. The articles run heavily to equipment, since for some time it was thought that we would be confined to that category of subject matter. What we lack and badly need are expressions of thought in the whole broad field of fire control—new views on our big, pressing problems and their solution. If articles are provocative and controversial, so much the better. The value of this periodical will be determined by what you and other readers contribute. Something in your fire-control thinking and work is interesting and helpful to others. Write it up and give other men some return for what they have given you.

We have room for long and short articles. Those familiar with the prewar issues will recall the interesting "shorts" which were interspersed throughout the pages. These were brief, compact notes—100 to 200 words—on new and interesting items. They brought sharp focus to limited, though often important, aspects of the fire-control job. We would like more of them.

In setting up FIRE CONTROL NOTES again we have followed closely the original format, arrangement of articles, and character of lay-out, but undoubtedly many readers will have good ideas for improvement and pepping up the style and appearance. We welcome criticisms and constructive suggestions. Special features or departments somewhat in the Reader's Digest style might add interest and liveliness. Perhaps we could run a column on "what's going on" which would carry brief news items on special activities, proposals for new experiments, unusual equipment developments, or even ventures in the realm of "imagineering." It might afford an outlet for what may seem to be wild ideas. A scheme or gadget is seldom practical in its original form, but presenting it in print enables others to help get rid of the kinks and perfect it.

And a final word to contributors. We want your articles and contributions badly, but we make a special plea that you read and follow the instructions on the inside of the back cover as to form and illustrations and save us some headaches. Putting out this magazine is an extracurricular job with us here, and we have neither the help nor time to rewrite, retype, or redraw.

If you really want FIRE CONTROL NOTES, give us all the support possible and we will turn out a creditable periodical which fully serves its purpose.

Note to Contributors.—Many contributors or would-be contributors on fire-control subjects may be a little puzzled as to whether to send a prepared or prospective paper to FIRE CONTROL NOTES or the *Journal of Forestry*. Both are now available to them. At the time of the Equipment Committee meeting in Washington, January 1945, a joint arrangement was worked out for insuring suitable outlets for all fire-control subject matter. At that time the proposed Fire Equipment Notes had to be restricted to fire equipment items. Under that limitation it was agreed that there would be a free interchange of papers submitted between the editor of FIRE CONTROL NOTES and the staff of the *Journal*.

The plan was that the broader subjects would be referred to the *Journal*, with perhaps a "brief" covering their content, particularly as it affected fire equipment, to be printed in FIRE CONTROL NOTES. It was suggested, too, that both publications carry cross references on important developments in the field of fire control described in either. The removal of wartime limitations on subject matter for FIRE CONTROL NOTES now changes this situation, and the question of deciding where a contribution should appear will need to be reviewed again with the pending successor to Editor Samuel T. Dana of the *Journal of Forestry*. However, the writer himself can usually decide pretty well if he will keep his audience in mind. The two audiences differ somewhat.

Readers of the *Journal* are interested in forest fire control in its broader aspects, and in new ideas, methods, and equipment which have wide application. However, they are not interested in many of the mechanical details of how things are made or done. The readers of FIRE CONTROL NOTES, on the other hand, are assumed to have a specialist's interest in fire-control techniques and are a better audience for subjects in these categories. A large proportion are field men particularly interested in things they can put to use in their everyday jobs. The publication serves that need. But the editor of FIRE CONTROL NOTES is also very much interested in publishing material on the philosophy of fire control and many broader subjects. The editor of the *Journal of Forestry* is also interested in these subjects and in getting better coverage of administrative and so-called "nontechnical" fire-control material that represents progress and new thinking. In such fields many contributions will be appropriate to either publication.

For the most part, the choice will be left to the writer, but there is no objection to referring any paper to either editor with the request that it be used where it seems most appropriate. In general, a new idea or gadget that has not yet been fully tried out may be reported in FIRE CONTROL NOTES but is usually not regarded as eligible for the *Journal* until some definite conclusions can be drawn as to its field of usefulness. When that stage has been reached, it may be eligible for either, depending on the author's choice with the different audiences in mind. In many cases it will be worth while for articles to appear in both.—A. A. BROWN, *Associate Editor, Journal of Forestry.*

UNIT PROTECTION BY AIR CONTROL

Northern Region, U. S. Forest Service

Smoke jumping was started in northern Washington in 1939. Early in 1940 the new project was moved to Montana and during the succeeding six seasons the activity progressed steadily through the difficult experimental stages into a practical, full-blown operation which now serves parts of Regions 1, 4, 5, and 6. Now comes a new phase of aerial control. The air personnel and facilities are beginning to take over the tasks of patrol and detection in addition to those of suppression. That this has been done effectively and economically for a selected forest area is evident from this interesting account of an important pioneering effort.

A thorough test of airplane detection of fires combined with smoke-jumping patrol has proven successful on some of the most inaccessible areas of the national forests in Region 1.

In former years, control of fires by the use of smoke jumpers has proven economical, but airplane detection was not entirely feasible. This made it necessary to retain a lookout system in every area, even though better and faster suppression could be obtained with smoke jumpers. Thus a duplication or overlap of coverage was required.

The Continental Unit

The region in which air patrol was tried is known as the Continental Unit, embracing 2,054,000 acres of remote and inaccessible forest land in the Lewis and Clark, Lolo, Helena, and Flathead National Forests. Elevation ranges from 4,000 to 9,000 feet along the Continental Divide which runs north and south through the middle of the region. Inaccessibility and the heavy manning required to give adequate ground-crew protection, along with low man-caused fire occurrence, made it an ideal unit for development of fire control by aerial methods.

Forty-three lookout-firemen positions were discontinued on the Continental Unit, and the money was set aside for flying patrol, training smoke jumpers, etc. The objective was to determine whether better protection could be obtained with the same or less expenditure. Nine lookout-firemen positions were retained to give detection coverage to some of the areas of highest fire occurrence, report the occurrence and path of lightning storms, and furnish data from which the Weather Bureau made special daily forecasts.

In the 1945 season, there were 29 fires on the Continental Unit: 18 were class A, 8 class B, and 1 each classes D, C, and E. All but 5 were attacked from the air, and in addition smoke jumpers suppressed one 120-acre fire by ground attack.

Lightning caused 27 of the fires, a camper 1, and the other, a class E fire which burned 2,270 acres on the extreme boundary of the unit, was started by an automobile exhaust during a high wind. Altogether, 2,413 acres were burned, or 0.11 percent of the area in the Continental Unit.

Faster Attack

It is interesting to note that of the 29 fires, 14 were discovered by aerial observers, 7 by lookouts, and 8 by others. Of the fires controlled with less than 10 acres burned, 4 were potentially dangerous. One fire—on which discovery, report, and first action took only 47 minutes by air control—had an average perimeter increase of 4.4 chains per hour in low-low fuels. This fire would have taken ground forces, by conservative estimate, at least 6 hours for the first attack. The wind was 15 miles per hour and the burning index 71 at the nearest lookout.

Another fire on the same day was controlled at 0.2 acres. Action by air took only 30 minutes after the report was made. At least 6 hours would have been required by ground forces.

Airplane delivering smoke jumper by parachute to spot near forest fire.

Two other fires, with a burning index of 100 at nearby stations, were controlled on this day with total burned acreage of 0.05 acres. These would have necessitated at least 5 hours' travel by ground crews, but air attack averaged 2 hours and 30 minutes. And this was longer than the average because only 2 planes were used to handle 6 fires.

Better Protection—Less Cost

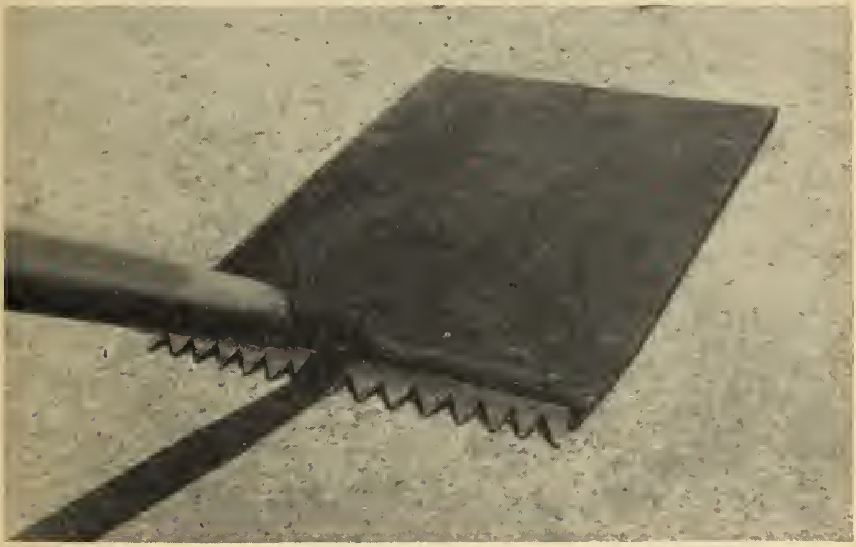
To finance this experiment, allotments ordinarily made to the forests for wages were spent as follows:

Overhead expenses	$6, 240
Patrol flying	7, 442
Smoke jumpers	4, 320
Equipment and supplies	1, 434
Subsistence	1, 107
Operation of motor equipment	315
Travel expenses	165
Total	21, 023

It was demonstrated quite definitely that better protection in such areas as the Continental Unit can be obtained by substituting aerial control for lookout-firemen. At first glance it would appear that no money was saved, but this is far from true. Elimination of 43 lookouts makes it unnecessary to maintain lookout structures and telephone lines and trails to these points. Many other trails and improvements used for fire control alone can possibly be abandoned. There are also other savings, such as reduction in pack stock requirements, overhead for training guards, etc.

It is likely that another unit will be set up in the back country of the Bitterroot, Nezperce, Lolo, and Clearwater Forests.

Special Fire Swatter.—The Blackfeet Indian Reservation fire employees consider the fire swatter their standard tool for control of grass fires. They have found that on many occasions, in order to make the fire line safe, a rake or similar tool was needed to scarify isolated tufts of grass, dung piles, small areas of duff, etc., which were holding fire. Finding it impractical for one fireman to carry both a swatter and rake, a combination tool was made by replacing the rivet bar on the standard swatter with a scarifier made of ⅛- by 1-inch angle iron. Details are shown in the accompanying illustration. To use the scarifier, the handle of the swatter is held slightly lower than the position in which it is held when using the flail.—CHARLES R. GERARD, *Forest Guard, Blackfeet Indian Agency, Mont.*



The Gerard fire swatter, showing detail of toothed rivet bar used as a scarifier.

ADAPTING ARMY EQUIPMENT TO FOREST-FIRE FIGHTING[1]

MAJOR C. A. ROWLAND, JR.

Air Corps, Chief Forestry Section, Eglin Field, Fla.

Major Rowland, a forest officer in Region 8, was commissioned at the beginning of the war and placed in charge of the protection of the large area included in the A. A. F. proving ground in Florida. Due to almost continual aerial practice, testing and incendiary bombardment, the area was a hot one and its protection became a difficult job. In this work Major Rowland was able to secure most of the mechanized units he thought suitable. His adaptations of military equipment to fire-control uses were made with a good sense of design, appreciation of balance and loading limitations, and the best of mechanical workmanship. His experience will be a sound guide when military automotive equipment is finally made available as surplus property.

In June 1940 the Choctawhatchee National Forest in northwestern Florida was transferred to the War Department and became the Army Air Forces proving ground, with headquarters at Eglin Field. This area, of some half million acres of extremely sandy soil, is principally forested with longleaf pine with a scrub-oak understory. The area is characterized by flat ridges which break abruptly to the streams, the majority of which are fed from subterranean sources. On either side of the streams there are comparatively narrow swamps with areas of "flats" adjacent to the larger swamps which are marshy, with a ground cover of wire grass.

Prior to its transfer to the War Department, the United States Forest Service had administered this area since 1909. As fire protection had been practiced for many years, the ground cover and litter became extremely rough and susceptible to fire. The scrub oak, prevalent in the understory, had increased both in size and density because of the fire protection.

Forest fires in this area are almost entirely surface fires, but because of the heavy "rough" and wire grass, there is a rapid rate of spread. It was learned by the Forest Service, that direct attack with water was the best method of stopping the spread of fires here. Fire-fighting technique naturally developed around water-carrying trucks, followed by men to patrol and mop up the numerous snags and debris.

Army Equipment Used

When the War Department took over the area, the fire-detection system was retained and six ½-ton two-wheel-drive pick-up trucks were procured on which were amounted 120-gallon water tanks and Panama fan-belt-driven pumps with the necessary hose and hand tools. These were well-designed units, but with the increase in military operations and the corresponding increase in use of the sand roads and fire lines by heavy trucks, it became impossible to furnish adequate fire protection to the area with these trucks. The fire occurrence was increased by bombing and gunnery missions, despite precautions taken in clearing the ranges and burning off safety zones around them. It became evident that trucks capable of carrying more water, which could traverse the extremely sandy roads and operate on marshy lands, were needed. The fire trucks of the Corps of Engineers were designed for combating structure fires, and the crash trucks were specially designed to fight chemical fires, and regulations prohibited their use for forest fires. The "brush trucks," designed by the Corps of Engineers, were inadequate for conditions encountered, as they had only 2-wheel drive with exposed pumps and fittings which made them impractical for cross-country use. The pumps furnished more water than was ordinarily needed for local conditions, where a small stream of water, which will last for a long period, is of prime importance.

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[1] Reprinted in slightly condensed form from *Mechanical Engineering*, July 1945.

In 1941, several available types of standard Ordnance vehicles were test-driven in an effort to determine the best all-round vehicle to convert to a fire-fighting truck to meet the needs of this reservation. It was found that the 1½-ton, 4 x 4 Chevrolet cargo truck with 7.50–20 tires was the best available vehicle at that time for a heavy-duty forest-fire truck. For a light patrol truck to replace the ½-ton two-wheel-drive trucks originally procured, the Ordnance ½-ton, 4 x 4 Dodge with metal cab was selected. The Panama pumps in use had given satisfactory service, furnishing sufficient discharge and pressure, so these were used chiefly. The first truck converted was a 1½-ton Chevrolet 4 x 4 cargo truck. Seat frames, tarpaulin, and bows were removed and tanks, with a capacity of 500 gallons, and a new Panama pump were mounted on the truck. This unit proved superior to the lighter two-wheel-drive pick-up both in its ability to reach inaccessible places and to carry sufficient water to combat large fires.

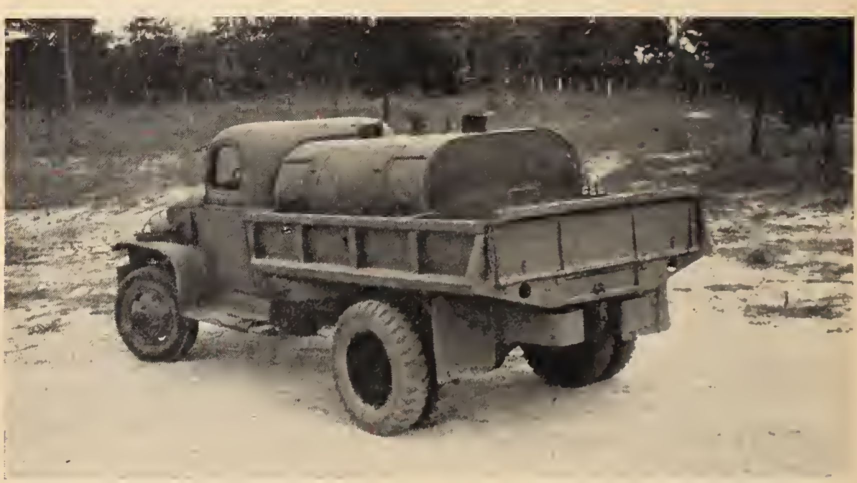
The advantages of the Army-type vehicles with their rugged construction and four-wheel drive were obvious, so all the fire-fighting equipment was converted to four-wheel drive, and experiments were made with as many types of vehicles and pumps as could be secured, to determine the most effective combination of chassis, pump, water tank, and nozzles. The original ½-ton pick-ups were replaced by 4 x 4 Ordnance ½-ton pick-ups with 7.50–16 tires, to which the equipment from the two-wheel-drive trucks was transferred. The following report covers the equipment tested.

Chevrolet 1½-Ton Cargo Truck

The first vehicle to be adapted was an Ordnance 1½-ton, 4 x 4 (2–DT) Chevrolet cargo truck with steel cab and body. Tanks having a capacity of 500 gallons were mounted, and a Panama fan-belt-driven water pump with compensating bypass was installed. This vehicle is well adapted for use as a heavy fire truck in making the main direct attack on forest fires encountered in this locality, with the exception of those on wire grass flats. Its power, maneuverability, and water capacity make it the most satisfactory all-round heavy-duty fire truck tested. It is capable of traveling over rough roads and cross country with a full load, except in flats where the muck is so soft that it will not support the weight.

A similar installation on an identical chassis was made, using a Yale-Towne fuel-transfer pump, operated by a power take-off. This unit gave substantially the same operating efficiency as the preceding unit, the essential difference being the pump. Since the Yale-Towne pump was designed for large volume discharge at low pressure, it refills the tank from natural sources more rapidly than the Panama pump, as two discharge hoses are used simultaneously.

One of the trucks converted was equipped with a winch mounted in front of the radiator, operated by a power take-off. This has proved very effective in enabling the truck to pull itself or other trucks out of sand or mud.

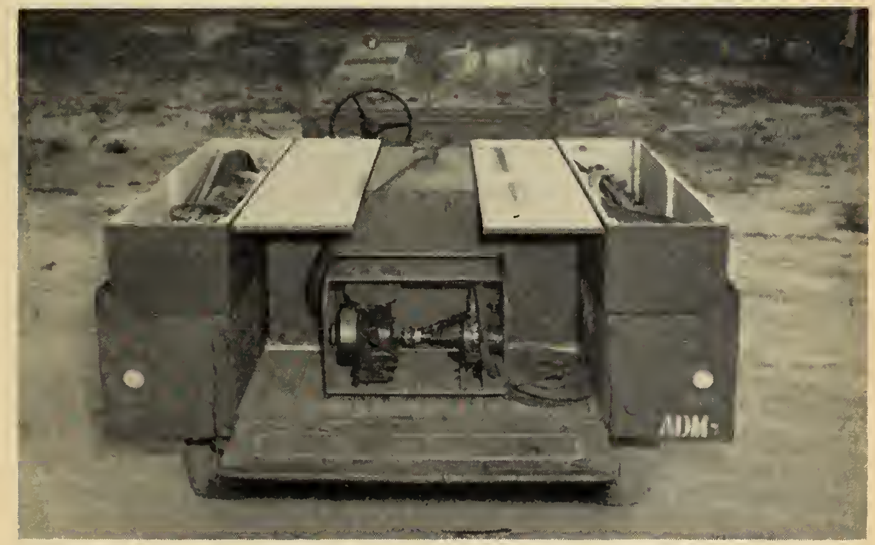


Chevrolet 1½-ton cargo truck showing 500-gallon tank and discharge hose from Panama pump on left front fender. Short hose reduces pressure loss and is adequate for ordinary use; 50 feet of extra hose is carried in truck.

Three-Quarter-Ton Dodge Weapon Carrie

An Ordnance ¾-ton Dodge weapon carrier was converted to a forest-fire-fighting truck by removing tarpaulin, bows, and seat frame and installing a 200-gallon water tank and a Panama fan-belt-driven pump. A metal cab was installed, made of welded tubular steel covered with galvanized sheet iron. Difficulty was experienced in mounting the Panama pump because of the location of the top water-hose connection and generator. This was overcome by making an offset adapter for the base of the pump by bolting two pieces of 2-inch angle iron together, one of which was drilled for the cylinder-head bolts and the other was drilled to match the holes in the base of the pump. This set the pump out 2 inches from the cylinder-head bolts and down 2 inches below the level of the top of the cylinder head and gave adequate clearance between the pump pulley and the radiator hose.

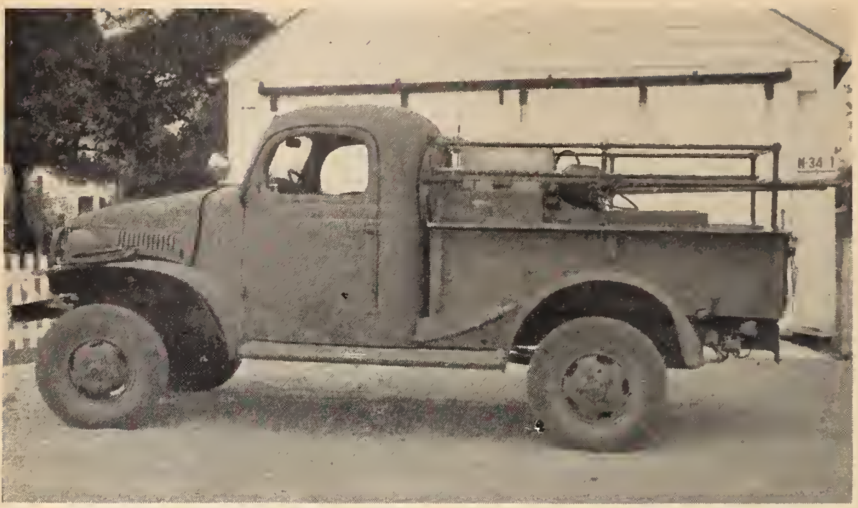
This vehicle handles better than the ½-ton pick-up and its very short wheel base makes it highly maneuverable in the woods. It has ample power, and its large tires (9.00–16) and four-wheel drive give it better traction and more road clearance than the ½-ton pick-up. It is able to travel in more swampy conditions than can either the ½-ton or 1½-ton trucks. While the ¾-ton truck has been used in primary attack, it has less water capacity than the 1½-ton truck and is better suited as a secondary truck, following one of larger capacity. When the fire weather is not extremely bad, this truck can replace a 1½-ton truck. It is the best all-purpose "light" truck tested. Tests demonstrated that 200 gallons is the largest volume of water that can be mounted on this type vehicle without excessive overloading. With this volume, two extra spring leaves had to be inserted in each of the rear springs. The improvised cab without glass makes it less desirable for the driver because of exposure to heat and smoke, but being open allows the hose man to operate the hose from the seat. It is not well adapted to the installation of radio because it does not sufficiently protect the equipment from weather.



Dodge ¾-ton weapon carrier. View taken before installation of cab and Panama pump. Tool boxes replaced seat frames. The pumping unit is a type A-6 fuel-transfer unit, used as an auxiliary fire pump.

One-Half-Ton Dodge Pick-Up

The standard Ordnance ½-ton, 4 x 4 Dodge pick-up with metal cab made a desirable substitute for the original ½-ton pick-ups. Tarpaulin, bows, and seat frames were removed from the truck and the equipment was transferred from the two-wheel-drive pick-up with only minor modifications. It performed as well as the original ½-ton pick-up truck, and the larger tires (7.50–16) and four-wheel drive enabled it to operate on terrain on which the 4 x 2 truck could not travel. The rugged construction reduced the damage to the vehicle when traveling through heavy brush to a minimum. This truck handled its load so well that larger tanks were installed with satisfactory results. Although the original tanks had a capacity of only 120 gallons, 175- and 200-gallon tanks were tested. The rated capac-



Dodge ½-ton pick-up truck equipped with 120-gallon tank, radio installation, hand tools, and discharge hose mounted on left front fender.

ity of the vehicle was exceeded, but it was found that good performance could be obtained when a 175-gallon tank made of ³⁄₃₂-inch sheet iron was installed. The 200-gallon tanks made of heavier material were found to be impractical.

This vehicle is primarily used for forest patrolling and as a secondary truck. Its effectiveness as a patrol truck is greatly increased by installation of a two-way FM radio to keep the dispatcher informed as to the progress of fires and in reporting unusual conditions encountered.

The small water supply limits its effectiveness in furnishing the main direct attack on large fires without support. Its best use in fire fighting has been that of a secondary unit to follow the larger trucks to prevent break-overs or handle small fires which blaze up after the larger trucks have passed. Using the pick-up as a secondary truck reduced the number of men required for patrolling and mopping up fires.

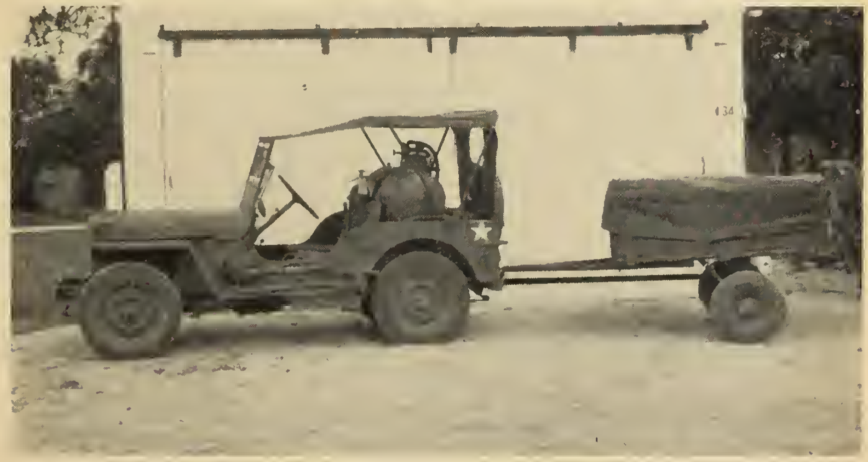
This truck does not have quite the maneuverability or speed of the two-wheel-drive pick-up. As it gets older the steering becomes stiffer and there is more front-wheel vibration, causing greater wear on the front tires. Operating these vehicles on sand roads necessitates frequent replacement of universal joints, particularly on the front drive shafts. The hydraulic-brake tubes are exposed and are frequently damaged in cross-country operation. The truck makes a satisfactory all-round patrol truck, but is underpowered for the job it is performing. The ¾-ton weapon carrier would be a much more satisfactory patrol truck if it had an enclosed cab.

Since the tank capacity is limited, experiments were made with smaller nozzle openings to conserve water. With the 0.25-inch tip, the 120-gallon tanks lasted only 7 to 10 minutes, which is not sufficient time to corral even small fires. It was found that good streams of water were furnished with a properly designed tip having an opening of only 0.14 inch. With this tip, the water supply lasted more than twice as long and was practically as effective in stopping fires, since increased pressure, created by the reduction of the size of the tip, caused the water to be broken down into finer droplets, approaching fog, which gives more efficient utilization. The small tips so increased the effectiveness of the water supply on the pick-up trucks that they were equipped only with that size tip. The same conservation of water was applied to the larger trucks by equipping each with two tips, the 0.14-inch tip being used on all fires except at the heads of large fires and during conditions which made small tips inadequate.

Quarter-Ton Reconnaissance (Jeep)

The vehicle tested was a standard ¼-ton, 4 x 4 Willys reconnaissance (jeep), equipped with 6.00–16 tires. In converting the jeep to a light fire-fighting and patrol vehicle, a 40-gallon pressure tank, salvaged from a soda-acid fire extinguisher, was mounted horizontally immediately behind the front seats. This location was selected so that the weight would be as far forward as possible to distribute the load. On this tank, a tire-tube valve was installed so that air pressure could be applied to force the water out. In addition, a 15-pound carbon-dioxide (CO_2) cylinder was installed so that the pressure could be maintained as the water was forced out. A valve is located to control the flow of water to a 50-foot ¾-inch hose. The nozzle was reduced to ⅟₁₆-inch opening. A pressure gage and pressure-relief valve were installed for safety. The tank can be refilled through the refill opening or by use of vacuum. A vaccum line was run to the intake manifold of the engine, using ¼-inch gasoline-type fittings with ¼-inch copper tubing. A control valve was mounted on the tank and the bleeder valve installed to trap moisture which can be drawn off as necessary. When the vacuum refiller is used, the discharge hose becomes the suction hose.

Thirty-five gallons of water are ordinarily used, allowing approximately a 5-gallon capacity for head space. Pressure on the tank



Jeep and ¼-ton jeep trailer in which Pacific marine pumper, 1,000 feet 1½-inch hose, and accessories are mounted.

is ordinarily kept at 75 pounds, being put in by any air hose or hand pump. As this will not discharge all of the water, the pressure is maintained by periodically opening the valve slightly on the CO_2 cylinder until the operating pressure of approximately 40 pounds is reached. The use of compressed air to build up the original pressure reduces the amount of carbon dioxide needed. Fifteen pounds of carbon dioxide will discharge the tank 5 times. With a nozzle having a 3/16-inch opening at an average of 40-pound pressure, the water supply will last 40 minutes and produce a thin stream which can be sprayed 35 feet. By using the motor vacuum and the hose without a nozzle, the water can be replaced in the tank by vacuum in approximately 4 minutes under normal conditions.

The jeep has been used for all types of patrol activities and is especially good at reaching normally inaccessible places on the reservation. Its most spectacular use has been as a reconnaissance car for a fire "boss" on large fires from which he can watch the operations and make necessary reconnaissance to determine the action to be taken. With its water tank, it is especially useful in this capacity as it can be used to put out any break-overs that may be encountered by the fire "boss" while on reconnaissance. It is very effective in combating lightning fires as it can reach almost any place, and the amount of water carried is sufficient to handle small fires under normal conditions. It can operate on softer ground than any other vehicle tested. The jeep can pull the 1-ton cargo (tool) trailer or the 1-ton 250-gallon water trailer, but these are ordinarily pulled by ½-ton or larger trucks. It is the ideal vehicle for pulling the jeep trailer carrying the Pacific Marine Pumper. The only difficulty encountered in operating the jeep in thick scrub-oak woods is the damage to the top. However, rips which usually occur near the bows can be easily repaired by a shop equipped to handle canvas.

Trailers

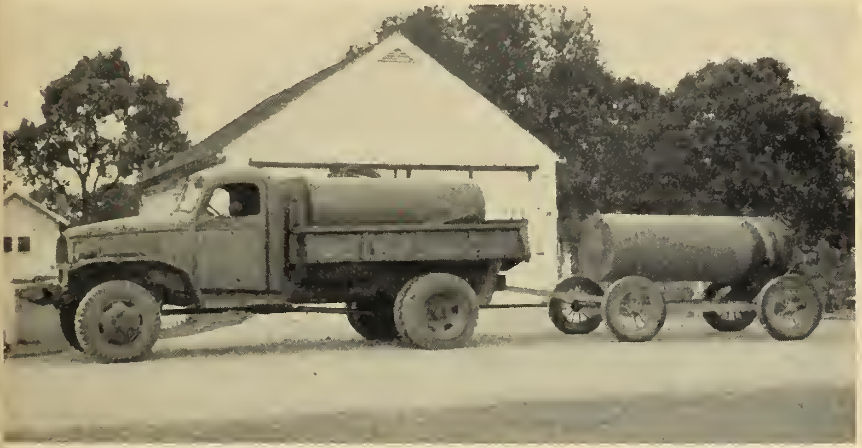
The large acreage of land under protection made it desirable to motorize all fire-fighting equipment possible. In order to make fire tools and special equipment readily available for dispatch, use was made of Army-type trailers. All of the trucks are equipped with trailer hitches, so towing presented no problem.

The Nash-Kelvinator 1-ton, two-wheel cargo trailer made an excellent portable fire-tool box. Three of these units were equipped and located at strategic places for most efficient use. Each was equipped with a complete assortment of hand tools for 50 men. All tools have distinctive markings so they can be replaced on the proper vehicle after use. These kits have saved much lost time in handling tools, and immediately after fires they are made ready for future use. The tarpaulin and tool boxes on the trailers protect them from damage or weather. The 50-man kit consists of the following tools:

10 rakes, asphalt.
10 hoes, council.
15 shovels.
2 saws, cross-cut.
4 axes.
4 pumps, back pack.
4 lanterns, kerosene.
1 burner (back-fire torch).
1 pair snaking tongs.

The 1-ton, 250-gallon Lavine two-wheel water trailer has been used without change as an auxiliary water supply to refill fire trucks and furnish drinking water to fire-fighting crews. In cases where fire fighting was on open land, or where buildings or targets were protected, these trailers have carried an auxiliary water supply directly to the fire behind pick-ups and, when the tank supply of the pick-up was exhausted, the water was pumped from the trailer directly onto the fire by use of a long suction hose from the pump to the trailer.

The 750-gallon four-wheel trailer tank is used as an auxiliary water supply on large fires and to furnish water for the Pacific Marine Pumper when it is operated away from a natural water supply. Use has been made in refilling fire trucks at fires, where the water is pumped from the trailer into the truck by a No. 325 engineer brush truck, the Pacific Marine Pumper, or type A–6 fuel-transfer unit. This trailer has been used, towed by a 1½-ton cargo truck, in protection of buildings or targets, by installing the Pacific Marine Pumper in the bed of a 1½-ton cargo truck and pumping water from the trailer.



The 750-gallon four-wheel trailer tank drawn by 1½-ton truck.

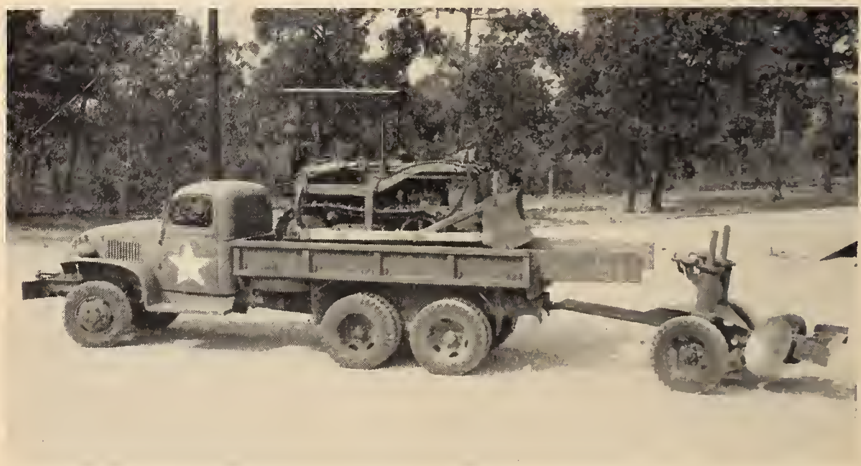
A type A–6 fuel-transfer unit has been mounted directly on this trailer to increase its efficiency in refilling trucks. The unit has a large volume discharge, which enables it to pump considerably more water than the pumps on most of the trucks.

The ¼-ton jeep trailer, which was originally designed as an experimental trailer for use with the ¼-ton reconnaissance car (jeep), has been adapted to use as a carrier for the Pacific Marine Pumper, its fittings and hose. The sides and gates were made of plywood and the containers for the pumper and 1,000 feet of hose can be removed from the trailer. Wooden cleats were fastened to the floor of the trailer to hold each box in place. A cover was made for the entire trailer and its cargo and no other adaptations were necessary.

Mobile Fire-line Plow Unit

The Mathis two-disk fire-line plow is the best tested for this area. Used with the International tractor, T–6 or T–9, this plow makes a very efficient unit for fire-prevention and fire-suppression work. On fire-prevention work, the T–9 tractor is more desirable as it has more power and wider tracks which enable it to plow lines faster and farther into the edges of the swamps and on more marshy lands. The T–6 proved to be a more desirable tractor for use with the Mathis plow in fire-suppression work. It can be transported on a 2½-ton truck, which carries skids and pulls the Mathis plow mounted on pneumatic tires. On suppression work the plow can be disconnected, the tractor unloaded and rehitched to the plow and ready for use in 7 minutes.

On fire suppression, this plow has been most effective when following one of the larger water trucks to plow a line around the fire at the edge of the burned area. This greatly reduces the number of men required for patrol and mop-up. The plow is also used to prepare lines from which backfire can be started safely and to reach places which are inaccessible to the trucks. In wire grass it is often possible to stop fires with a plowed line, in places where trucks cannot always be operated.



International T–6 tractor and bulldozer loaded on 2½-ton G. M. C. cargo truck trailing Mathis two-disk fire-line plow.

Specifications of Equipment Tested

	1½-ton cargo truck	¾-ton weapon carrier	½-ton pick-up	¼-ton jeep
Make	Chevrolet	Dodge	Dodge	Willys.
Capacity ... tons	1½	¾	½	¼.
Driving wheels	4 x 4 (2-DT)	4 x 4	4 x 4	4 x 4.
Tire size ... inches	7.50–20	9.00–16	7.50–16	6.00–16.
Pump	Panama and Yale-Towne.	Panama	Panama	Compressed.
Tank capacity ... gallons	500	200	120–175	40.
Hose, discharge ... inches	¾	¾	¾	¾.
Hose, suction ... inches	1	1	1	¾.
Nozzle tip ... inches	0.20 and 0.14	0.14	0.14	0.07.

SMOKE MASKS AND GOGGLES

Oley Scott

Mark Twain National Forest, U. S. Forest Service

Almost everyone with experience on the fire line remembers instances where a flare-up might have been handled and the break-over prevented if the crew, or only one good fire fighter, had kept on pitching even for a fraction of a minute. But the eyes and lungs couldn't take the acrid smoke any longer. The devices here described are not burdensome or hampering, and if they were more generally used, probably much less lost line would be reported.

In 1942, experiments were begun on the Mark Twain National Forest with the use of smoke masks and goggles by fire crews on close-in work on hot-spotting, burning out, or holding oncoming fire at a road or natural barrier.

The light fuels of oak leaves and grass had so much increased under protection that it was difficult to construct and hold a fire line on the higher danger days when the rate of spread was rapid because of strong and frequently shifting winds. Often, because of heat and smoke, crews had to fall back, with consequent loss of fire line, increased burned acreage, and discouragement of the fire fighters.

Various types of gas masks, respirators, and goggles were used experimentally. Trials showed that the smoke masks and gas-proof goggles permitted fireguards and fire fighters to hold a fire under conditions that would be intolerable without such protection from smoke and heat. It was found that protection of the eyes is as important as of the nose and throat and therefore the goggles must be gas-proof.

Standard Equipment

The smoke mask and gas-proof goggles are now accepted as standard equipment for fireguards and initial-attack crews on the Mark Twain Forest. Seasoned guards carry their masks at all times when on fire duty. Local crewmen who are repeatedly called to fight fires request this device as part of their equipment when hired for fire-suppression work.

When not in use, the mask is suspended around the neck and the goggles are pushed up on the head. It takes but a few seconds to adjust the device, which can be readily removed from the face when not needed.

Several types of masks and goggles that may be used in fire fighting are manufactured. The Mark Twain Forest has experimented with and found quite satisfactory Carter's combination gas mask and goggle and Cover's new gas mask and gas-proof goggles. Cover's goggles have a very effective device for preventing the lenses from fogging up. Each eye piece has a water chamber that should be kept filled; a nod or shake of the head clears the glasses of moisture.

The Army goggle M–1944 is now being tried, but until it is used more extensively on actual fires, no definite recommendations can be made.

HELICOPTER HOPES FOR FIRE CONTROL

David P. Godwin

Assistant Chief, Division of Fire Control, Washington Office, U. S. Forest Service

It's an exciting field of thought—the employment of helicopters in fire control and other forest activities. Hopes long cherished but often dim are being renewed as technological advances take on the shape of reality. As the development of the hovering type of flying machine—known to the aeronautical profession as rotary-wing aircraft—moved forward by slow and painful steps, foresters began to dream of the revolutionary effects it might have upon their present ways of doing the field job. It seemed like a vehicle built to order. In the early 1930's we had a few opportunities to use the autogyro over some of the western areas. But the autogyro was a transitional type and did not free itself of the basic elements of the airplane. Now comes the helicopter.

Development of the Helicopter Principle

The pure helicopter principle has engaged scientific thought for centuries—Leonardo da Vinci designed one in the fifteenth century. But he, like hundreds of successors in this field, failed because of the lack of a sufficiently powerful force to lift or propel the machine. So it was not until well after the invention of the gasoline engine and some years after the first airplane flights that rotary-wing aircraft left the ground. In 1922, Bothezat, a Russian scientist, under contract with the United States Army, built his helicopter and made several short but successful flights. This was the real beginning of the practical development. The autogyro entered the field for a period and then under an appropriation from Congress in 1938, the Army Air Forces—acting for the military branches and a few civil agencies (including the Forest Service)—invited bids for design competition. Later, out of this action came the Sikorsky helicopter. In 1942, the Sikorsky XR–4 made its first flight and was the forerunner of the many war-inspired helicopters now in the air and performing, in the main, like grown-up airships and not toys.

During the past 2 or 3 war years there has been a ferment of design and production activity in this aircraft field, and now it is accelerated by the race to reconvert to peacetime requirements and compete in the commercial market just around the corner. Today there are about 50 aircraft organizations engaged in the manufacture or development of helicopters. This dramatic new development in air travel has excited the public interest; and due to Sunday-supplement articles, semiscientific magazine promotion, and the zeal of advertisers' artists, the whole thing has been overpromoted. Many people look forward confidently to buying soon a two-passenger job for about the cost of a flivver, or a chance to ride in a 50 passenger airline helicopter. For such people disillusionment is ahead.

Developments have reached a stage, however, where it can be said that the helicopter is the most versatile type of flying machine known to man, capable not only of vertical rise and descent within an area slightly larger than that swept by its rotors, but also of hovering, climbing, gliding, and flying forward, backward, or sideways.

Uses in Forested Areas

Because it can land and take off in very restricted areas, the helicopter could deliver men and supplies in thousands of spots throughout forested areas, such as flat ridge tops, small meadows or clearings, and in canyon bottoms. The Forest Service, if sufficient funds were provided, could extend the number of airplane landing fields beyond the approximately 90 now in use on the national forests, although topography would soon limit the number of available sites. Furthermore, the clearing and leveling of such sites is an extremely costly process. On the other hand, if perfected rotary-wing aircraft were available, there would be almost no limit to the number of small landing spots already provided by nature or which could be inexpensively prepared. With such an air-ground transit system, small well-trained and equipped crews could be transported to spots at or near small fires very quickly after discovery and report.

The helicopter would also have many other forest uses. On large fires men could be shuttled back and forth between fire camp and fire line, and prepared food taken to the fire fighters on the job. For various types of observation such aircraft has no equal. These include detection of fires, scouting project fires from the air, and prevention and law enforcement in areas where incendiarism gives trouble. Helicopters would be ideal for search and rescue work, livestock and game counts, and for survey and administrative travel in connection with range and timber management.

Most of the federally protected forest areas lie in the western mountains and are rough and relatively inaccessible. Millions of dollars have been invested in roads and trails constructed primarily and in some cases purely for fire protection. The large annual maintenance cost of these ground-transportation systems is an additional financial burden. A well-planned and skillfully managed helicopter operation conceivably could provide a degree of protection justifying a reduced road-building program and abandonment of some existing routes.

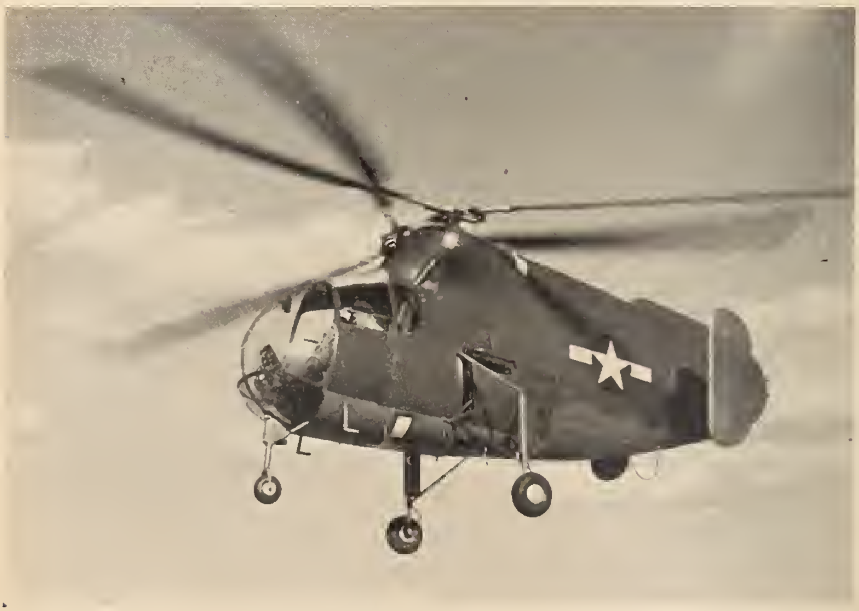
Given certain assumptions as to helicopter performance, such as pay load, hovering and service ceilings, cruising range, speeds, and operating costs, it should be relatively easy to prepare a helicopter fire-control plan. Actually, several of our western regions have selected sample areas and worked out on paper and maps the location of hub or operating points, degree and time of coverage, suitable dispatching schemes, the elimination of existing facilities and personnel, and have set up rough comparisons of the costs of the respective systems.

Prospective Designs

The aeronautical principle of the helicopter has been proven beyond doubt, but mechanically there is a different story. Much has yet to be done to remove the "bugs" from the complex mechanisms. Corrections and refinements must come in rotor-blade construction, power transmission, and the hub design and assembly, and lighter and stronger metals must be employed. Another important and interesting time-taker in this feverish evolution is the matter of arrangement and number of rotors, which the aircraft designers call "rotor configuration." A struggle is on between the advocates of these different helicopter conceptions. A great number of configurations have been worked on, but basically there seem to be about a dozen. No doubt these will shake down to less.

We laymen are easily lost in these aeronautical competitions and prophecies as to which rotor schemes will survive, but it is possible to state oversimply what the present outstanding patterns are. There appear to be about six: (1) Single rotor with tail rotor to counteract torque as in the Sikorsky helicopter; (2) two rotors mounted on either side of the fuselage but clearing as exemplified by the Platt-LePage machine; (3) two rotors mounted on either side of the fuselage but synchronized and intermeshing as demonstrated by the Kellett design; (4) two rotors mounted in tandem (fore and aft) but clearing as illustrated by the Piasecki; (5) two rotors mounted in tandem but overlapping in sweep as exemplified by the Magill; (6) two coaxially mounted rotors (one superimposed above the other) as in the Hiller or the Bendix.

Together or singly, P. A. Thompson and I have visited the plants of six leading helicopter manufacturers to make a rough survey of the progress being made, to discuss with these men the possible forest uses of rotary-wing aircraft, and to fly in some of the models. Also, for a long time we have had contract with industrial designers and



The Kellett military model helicopter XR-8, which employs two 3-bladed intermeshing rotors

Sikorsky military helicopter R–5 which, with enlarged cabin, will be the basis for the Sikorsky commercial four-place model.

engineers and with officers of the Army Air Forces helicopter development section. We have familiarized industrial producers with our fire problems and fire-control methods which we believe the helicopter can improve upon, and invited them to demonstrate—under flying contract if necessary—what these machines can really do in the actual ground and air conditions presented by our rough mountain terrain. One or more will probably respond to this invitation during the early summer of 1946.

As is generally known, the three Sikorsky models were the only helicopters produced in quantity for the A. A. F. As roughly graded by their power, these are the R–4, 180 horsepower; the R–6, 235 horsepower; and the R–5, 450 horsepower. Several hundred of these were built and flown. The R–4 is a very light reconnaissance type and hardly suitable for any western forest work. The R–6 may have some applicability, but the R–5 is the most powerful, has fine performance, and is the prototype upon which the first Sikorsky commercial model, the S–51, will be based. The following data on the S–51, which will probably be produced in moderate quantity in 1946, help to visualize what the machine is like and can do:

Performance

(In NACA Standard Air)

High speed at sea level	miles per hour	103
Cruising speed at 65 percent brake horsepower	do	80
Minimum flying speed	do	0
Maximum rate of climb at sea level	feet per minute	1, 200
Hovering ceiling	feet	3, 500
Service ceiling	do	13, 000

Fuel consumption (cruising) approximate 28 gallon per hour.

Load Distribution

(Cruising range 150 miles)

Fuel (70 gal.)	pound	420
Oil (6.7 gal.)	do	50
Residual fuel and oil	do	30
Pilot (1)	do	170
Passengers (3)	do	510
Baggage	do	70
Useful load	do	1, 250

Weights

Gross weight (design)	pound	4, 900
Useful load	do	1, 250
Empty	do	3, 650

Changing the employment of this useful load to a distribution more suitable to our fire-suppression crew needs, the 500 pounds of fuel could be reduced to 350, thus releasing 150 pounds to be devoted to personnel and equipment. This would cut the cruising range down to about 100 miles but would permit the transportation of four men (including pilot) and 220 pounds of equipment. This is merely an example and leaves out of consideration the flying, hovering, and landing problems inherent in altitude.

The Piasecki PV–3 is, to my knowledge, the largest American helicopter. Its fuselage is 48 feet long and according to Mr. Piasecki it has flown with 10 passengers—unusual lift for a 550-horsepower engine. The model has been accepted by the Navy. Equal or greater weight-carrying capacities, we learn, are being projected by other builders. The biggest job we have heard of is the German helicopter, Focke-Achgens, powered with two 2,000-horsepower engines, which was in development during the war and the design of which was discovered and reported by a British Intelligence Mission. It was to mount two 55-foot rotors laterally, weigh 16 tons, lift 5 tons, and was intended to carry tanks and trucks across rivers and to hoist such loads as bridge girders into place.

Costs

What will helicopters cost? We ask that question frequently but there is no definite answer. It is quite understandable that manufacturers can as yet set no prices. Great expenditures for research and engineering have gone into present models which have been virtually hand-made. Even though all makes still have "bugs" to be worked out, it is likely that three or four leaders will go into moderate commercial production sometime in 1946 and at that time will quote. As production progresses, costs will decline and probably reach a point where helicopters can be had for prices 30 to 50 percent in excess of airplanes of equivalent pay load and other comparable characteristics. The difference in cost between the two types of aircraft will be the price that customers will have to pay for the unique performance which can be had in no other way. Because of the helicopter's inherently intricate mechanisms and vulnerable members, it is likely also that operation and maintenance costs will exceed somewhat those of comparable airplanes.

Helicopter pilots and mechanics are specialized, and due to the newness of this technology, few in number. They will come from the personnel of the Army or the manufacturers. In the whole country there are probably not 200 competent pilots. However, there is a surplus of airplane pilots, and questioning a number of authorities turns up a sort of average opinion that 30 hours of training is sufficient to make a helicopter pilot of a capable airplane pilot.

Tests in National Forests

We now have high hopes for an early comprehensive field program of test and demonstration of the adaptability of the helicopter to forest work under actual forest conditions. Last summer and fall many contacts were had with officers of the A. A. F. relative to the Forest Service proposal of military aid during the 1946 season, involving an experimental as well as operational project. The experimental project will include two phases: (1) Experiment and test to develop, if possible, a technique of effectively dropping fire-suppression materials from airplanes and (2) test and demonstration of the suitability of helicopter operation as a part of the fire-control system. The latter only is pertinent to this article.

The whole plan was approved October 23, 1945, and a directive was issued by the Assistant Chief of Air Staff, assigning to the Continental Air Forces the task of setting up the projects as a cooperative endeavor with the Forest Service. For the helicopter project March Field in Southern California was selected as the center of operations, and the Angeles National Forest as the proving ground. In December 1945, two R–6 machines with crews were assembled at March Field and at this writing four more R–6's are due to arrive and two R–5 machines are expected to be assigned. These are, of course, the military types but will serve fully to demonstrate the adequacy of helicopter performance under those conditions.

The work plan provides for a series of tests to determine the limits of combinations of conditions, including load, topography, altitude, weather, and cover within which satisfactory performance can be obtained. These will be combined with or followed by tests of practical application of the helicopter in the many and varied proposed uses in Forest Service work. The results of these operations, which could be provided us only by the A. A. F., should put us far ahead in our knowledge of how we can employ this new scientific development.

So far helicopters have not flown our forested areas. Flights in a few comparable conditions have been cited, but comparisons and simulations are not definitive; and until these airships maneuver over our actual terrain and do the things we require of them, we will not know. The first tests with existing models may not be entirely conclusive, but if they are only fairly successful, we feel confident that in a reasonably short time the pending improvements in the mechanical elements will round out a vehicle that will mark a turning point in the progress of forest transportation.

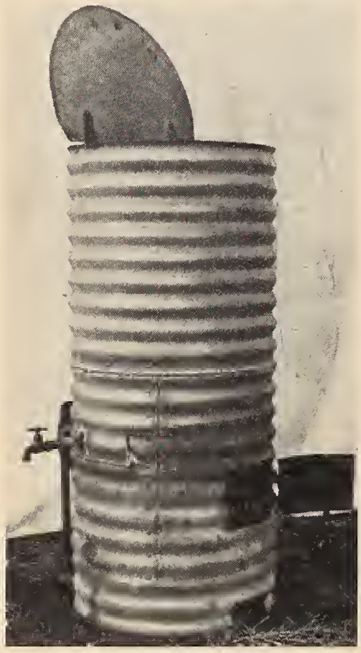
PORTABLE WATER HEATER

CURTIS E. PRICE

Forester, Siskiyou National Forest, U. S. Forest Service

The Siskiyou National Forest has tried a number of water heaters and, for use at large camps, has settled upon one made from culvert material which can boil 60 gallons of water in 35 minutes from the time of filling. Ordinarily, with most heaters it takes an hour to boil 60 gallons.

The heater is made from 24-inch culvert material and weighs a little over 100 pounds. The seams are welded and a partition, which serves as the top of the firebox and the bottom of the reservoir, is welded in. The total height is 56 inches, and the top of the firebox is 20 inches from the ground, which serves as the firebox floor. A notch 3 by 6 inches is cut at the bottom for draft. A fuel door 7 by 10 inches is cut near the top of the firebox and hinged as indicated. A collar is welded to the upper edge of the firebox at the rear to take a 6-inch stovepipe elbow. Three joints of pipe are ordinarily used. The top of the reservoir is closed with a hinged lid to keep out leaves and trash.



View of portable water heater, showing fuel and draft openings, carrying handle, faucet, cold water pipe attachment, and stovepipe elbow.

A total of 28 feet of ¾-inch pipe is used in making the coils. Three turns around the firebox are placed between the draft opening and the fuel door, and six lengths across the back half of the top of the firebox. Return bends are used in making up the latter and the lengths are, of course, progressively shortened as the side of the cylinder is reached. The cold water attachment to the coil enters the reservoir just high enough to clear the bottom.

The hot water entrance to the reservoir is 8½ inches above the bottom. Its location would not seem to make any difference, but Al Love, who designed and constructed the heater, says that after considerable experimentation it was concluded that heating efficiency was greatest with the location as indicated. Various lengths of coil were tried, and the arrangement described gave the best results.

DDT—FIRE-FIGHTERS' FRIEND?

H. T. Gisborne

Northern Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service

Can DDT, the new miracle insecticide, make living conditions more pleasant and healthful around fire camps? That is the question Region 1 set out to answer last winter.

Early in April 1945, 5 pounds of the powder was distributed by the region to several national forests with instructions for its preparation (solution of 1⅓ ounces of powder in 1 quart kerosene) and use. The plan provided that each forest in April or May count the number of flies, yellow jackets, mosquitoes, etc., found at each of two cookhouses or bunkhouses in a given locality; spray one unit and leave the other untreated; and report on form sheets the numbers and classes of live insects found 1, 2, 3, and 4 weeks after spraying.

Although the results were insufficient to warrant generalization, primarily because April and May were exceptionally cold and there was an abnormally scanty insect population at most stations, the possibilities of DDT as a friend of fire fighters were indicated.

Treated and Untreated Rooms

The report from Spotted Bear Ranger Station is typical. Before spraying, there were 20 live insects in the unit treated. One week later, there was none; 2 weeks later, one; after 3 weeks, none; and after 4 weeks, two. By contrast, in the untreated room there were 18, 24, 20, and 25 live insects after a lapse of 1, 2, 3, and 4 weeks, respectively.

Supplies of DDT powder were later furnished to several forest officers for use at fire camps. The one report received was highly complimentary but indicated that after 4 or 5 days less effect was apparent. This means either that the initial spraying had been inadequate or that the presence of a fire camp brings a very material influx of flies.

Tests were also made at two lookout stations, where flies and flying ants are sometimes a great nuisance. Results from merely wiping the sills and rails of the windows were remarkably good. One of the rangers immediately asked for enough DDT to treat all of his lookout houses next year.

No harmful effects have been observed in handling DDT, although at least one man has had his hands thoroughly covered several times by the dry powder.

GRAVELY FIRE-LINE BROOM

Albert Howard

General District Assistant, Houston Ranger District, Mark Twain National Forest

The Gravely tractor with rotary broom attachment was tried out on line construction in leaf-type fuels during the spring fire season of 1945 on the Houston Ranger District, Mark Twain National Forest, after original use on the Shawnee National Forest. Considerable information was obtained and definite conclusions reached which are of value in the future use of this piece of equipment.

Description of Tractor

The Gravely tractor, manufactured by the Gravely Motor Plow & Cultivator Co., Dunbar, W. Va., is a small two-wheel rubber-tired garden-type tractor, with five or six different attachments, such as plow, mower, rotary broom, etc. The broom consists of ten 24-inch sections of 6-inch fiber brushes, having an over-all width of 33 inches and diameter of 16 inches. It has a high and low rotary speed. Power is furnished by a 5-horsepower, one-cylinder, air-cooled motor. The tractor has two speeds forward and one reverse; over-all length is 92 inches and height to handle bars 40 inches. It operates on two wheels with rubber tires size 4.00 x 8. A walking operator handles the controls.

Use In Fire-Line Construction

During the 1945 spring fire season, this unit was used on initial attack on two class "C" and three class "B" fires. The crew on three fires consisted of one man in front with the rotary broom and two following to clean and widen the fire line. On two fires, the crew comprised five men, a boss, one with rotary broom, two cleaning and widening, one back-firing, and two patrolling and scouting. The indirect method of attack was used on all fires and rate of spread determined the distance between line and edge of fire.

The machine was used in four different fuel types:

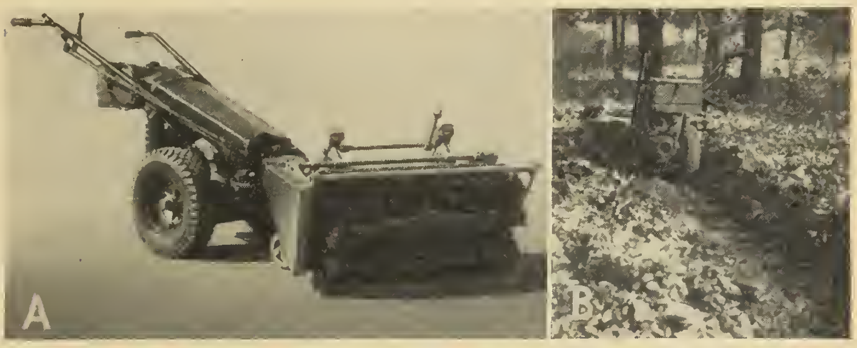
(1) *Short grass and weed fields.*—Here it was of no value because the rotary broom sweeps only loose material, such as leaves, and does not dig into the soil, as is necessary in grass. It simply bent the grass over, but did not clear any line.

(2) *Dense southern hardwood reproduction.*—In this type its use is limited, owing to the difficulty of maneuvering the machine through dense reproduction, but more particularly to the broom's inability to sweep a clean line. Short stubs are left from line clearing.

(3) *Fully stocked upland hardwoods and hardwood-pine types.*—Performance of the machine in this type was considered satisfactory. Line constructed was equal to four well-trained men with hand tools.

(4) *Upland open southern hardwoods.*—Here the Gravely broom made an excellent showing. The line constructed was down to mineral soil, and no cleaning with hand tools was necessary. It was possible to construct as much as 60 chains an hour with an estimated average of 30 chains per hour for all fuel types except grass fields.

The Gravely fire-line broom was used on slopes varying from 0 to 25 percent. Effectiveness on slopes above 15 percent was noticeably reduced when using rubber-tired wheels, due to lack of traction rather than lack of power. However, new cleated steel wheels have been purchased which it is believed will increase the unit's effectiveness on steeper slopes.



A: View of Gravely rotary fire broom. Note covered chain drive. F-433130.
B: Fire line, 18 inches wide and 90 percent clean, built by Gravely rotary broom in leaf fuels. F-433135.

The Gravely broom is easily loaded and unloaded by using two wooden runways and driving it into the pick-up under its own power. No great mechanical skill is necessary to operate and maintain it. Nor does it require much training to make a satisfactory operator out of the average fire fighter. Because of the shortage of fire fighters it was a very valuable tool during the past season.

Possible Improvements

Several possibilities are to be explored in improving the Gravely broom. An intermediate speed between high and low now available seems necessary. Some testing of wire or steel brooms, as against the fiber broom, also is desirable. Dirt and other debris cast up by the broom are thrown into the drive chain and gear, which should be moved to the other side of the machine.

TRAINING IN FIRE-FIGHTING TACTICS[1]

Glen R. Durrell

Director, Division of Forestry and State Parks, Oklahoma Planning and Resources Board

Here is an idea that can make training in fire tactics and fire strategy a lively and stimulating game. Every trainer would want to develop it a little differently to fit the particular needs of a specific group. But it has some elements that could be adapted to a variety of fire problems. Since it is essentially a graphic method, the description here cannot give a very complete picture of it. The author has agreed to send a limited number of samples of the cards and other devices he uses to readers particularly interested, in order to help in this respect.

In recent years there has been a steady advance in methods of constructing fire-control line, in equipment, and in training programs to increase the efficiency of the fire fighter in the production of held line. These are techniques that can be demonstrated, practiced, and used.

Our efforts at training in tactics and in fire-fighting generalship are largely confined to discussion, to analysis of disastrous fires, and to the school of experience. There is, of course, no substitute for experience, but when experienced men are not available it is obvious that we cannot set fires of the type our fire bosses must learn to handle in order to give them the necessary training.

Tactics Analyzer

To help meet this need in our Oklahoma organization we have developed what we call the fire-tactics analyzer. Expressed in simple terms it consists of plotting alternately the increment of the perimeter of a fire and of the control line by 15-minute periods.

Two rate-of-spread scales have been prepared for each fire-danger class; one for the burning period, the other for the night period. These scales show the spread of the head, flank, and rear of the fire by 15-minute periods. For a given fire-danger class in our particular area, slope is the principal factor affecting rate of spread. Therefore the scale is calibrated to show the distance the fire would travel down a steep slope, down a moderate slope, on the level, up a moderate slope, and up a steep slope for head, flanks, and rear in 15 minutes.

Another set of scales shows the amount of line that can be constructed in a 15-minute period by crews of various sizes, by direct and indirect attack, and by the various types of power equipment in use. Scales also show backfiring rates for trails and streams and for day and night travel for men and equipment, on trails and in the woods. For convenience, all scales are plotted on a basis of 16 inches to the mile. For training purposes, these scales were mimeographed on cards which show map distances in feet. A separate card was made for each danger class with the scales for daytime on one side, and for night rates of spread on the reverse. Separate cards were made for each of the line-construction methods, for backfiring, and for rates of travel. This diversity allows the fire fighter to use only the scales applicable to the problem at hand. For office use we find it convenient to scratch all of the rate-of-spread scales on one sheet of celluloid and the line-construction scales on another.

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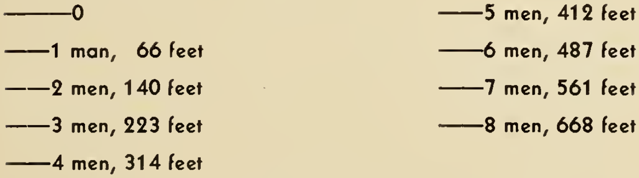
[1] Reprinted from *Journal of Forestry*, February 1945.

How the Device is Used

To use the device we first select the section of land on which the fire is to occur. We then refer to topographic and fire-control maps, and make a drawing of this section on a scale of 16 inches to the mile, using standard colors to show all contour lines, roads, trails, streams, and any other features that might affect the spread or control of a fire. A set of conditions is next agreed upon, including point of origin, time of day fire started, class-of-fire day, wind direction, elapsed time from start of fire until crew arrives, size of crew, and power equipment available. The proper rate-of-spread scale to fit these conditions is selected and the fire area is plotted in red lines on the map by 15-minute periods to represent its size and shape at the time the crews arrive.

The fire fighter then studies the problem on the map, selects a point of attack, and using the proper scales, draws in with a green line the amount of control line he could construct in 15 minutes with the number of men and the equipment assigned to him. The fire is then expanded by 15 minutes and the next 15 minutes of control line drawn in. This alternate drawing of fire line and control line continues until the fire is surrounded. (To plot the fire accurately at each 15-minute period, place a dot at frequent intervals out from the periphery, according to the slope on the map and rate of spread as shown in the applicable scale, then extend a line through all dots, thus establishing a new periphery.)



Rate of line construction in 15-minute intervals with indirect attack.

The burned area and the length of time required for control are then calculated. At this point the fire fighter behaves just as he does in the woods; he mops his brow and breathes a sigh of relief.

The lesson has just started, however. This is the time to discuss "What would have happened if." If line was lost through failure to tie down one end, by poor distribution of strength, by failure to start the control line far enough in advance of a rapidly spreading fire, or for other reasons, the cost of the error is determined by replotting the control line on the same diagram, and the difference in area burned and time required are calculated. If no line was lost, alternate points of attack or distribution of strength may be plotted to demonstrate better methods. On other diagrams the cost of excessive

HEAD FIRE

———0
——Steep Down, 59 ft.
——Moderate Down, 118 ft.
——Level, 198 ft.
——Moderate Up, 279 ft.
——Steep Up, 396 ft.

FLANK FIRE

———0
——Steep Down, 23 ft.
——Moderate Down, 47 ft.
——Level, 79 ft.
——Moderate Up, 119 ft.
——Steep Up, 158 ft.

REAR FIRE

———0
——Steep Down, 18 ft.
——Moderate Down, 35 ft.
——Level, 59 ft.
——Moderate Up, 89 ft.
——Steep Up, 118 ft.

Rate of fire spread in 15-minute intervals on a class-3 day, 10 a. m. to 6 p. m.

elapsed time can be indelibly impressed, as can the value of extra men and equipment. This kind of a session can be held on every fire fought on paper. The answers are positive and impressive.

Two general rules are followed in plotting the fire and control lines. First, tactics or equipment must not be used on paper in situations where it would be impossible to use them under field conditions. Second, the answer to almost all other questions that will arise depends on what the fire or the fire fighters would do in similar circumstances in the field.

Two methods may be used in setting up the problem: First, arbitrary selection to demonstrate a chosen set of conditions; second, selection by chance. Perhaps the second method does not have as much value as the first, but it does add a little zest to the work. For this purpose we use 13 pinwheels. Each dial sets up one condition. These dials are labeled fire danger class, wind direction, time fire started, part of section, section, township, range, discovery time, location time, get-away time, travel time, size of crew, and power equipment.

When the novelty wears off and the men become proficient in solving these problems under the conditions set forth thus far, we bring into play a fourteenth pinwheel, the "trouble wheel." It is divided into 32 sections, each one representing common conditions on the fire line. Some of the items are break-overs at various locations, arrival of volunteer help, loss of men, arrival of or loss of power equipment, changes in wind direction and velocity, etc. The spinning of this dial after each 15 minutes of control line is plotted gives valuable training in revising the attack to meet changing conditions.

Fire-control men may hesitate to attempt construction of the necessary scales for a device of this kind, and certainly scientists and researchers would have every right to question the accuracy of the figures we use, especially since we do not have danger stations in operation, and have not made any actual measurements of rate of spread or of line construction. We have not even defined in words the dividing line between moderate and steep slopes. Our figures are based on experience and observation plus a fair percentage of logic.

Results

Our concern as to the accuracy of the figures is not nearly as great since the device was put into use as it was at the start. We have found that when the same problem is assigned to several men there will be remarkably close similarity in the computed spread of the fire. We have plotted on paper a number of fires previously fought in the field, using the same set of conditions that occurred and the tactics employed at the time. The computed size and shape of the fire and the number of hours required to complete the control line check with such field experience within reasonably close limits. These two tests have convinced us that the scales are accurate enough for training purposes in the limited area for which they were designed.

It is recognized that for other areas the influence of fuel types, resistance to control, fatigue, and perhaps other factors may have to be considered in building the scales for rate of spread and control-line construction.

Of course, the real test of the value of this kind of training is in the results obtained in the field. Such results are hard to measure in a short period of time. We do know that when several men are given the same fire problem on paper the results in acreage lost will reflect quite accurately the amount of field experience each man has had. We know also that the results on paper improve as the man fights more "paper" fires. It is our hope that some of the paper experience and lessons will carry over into field practice.

In addition to training in suppression tactics, use of the device automatically trains the fire fighter in map reading. If the problems are set up in the area to which he is assigned, as they should be, he will gain considerable additional knowledge of his territory.

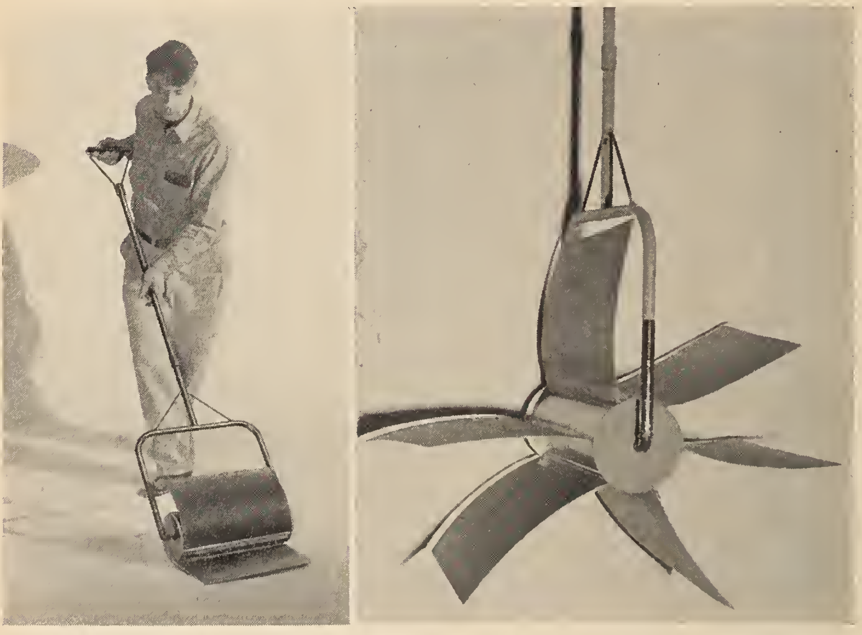
As knowledge of rates of spread and of rates of construction of control line accumulates, and as first control maps are improved, we believe that increasing use can be made of the analyzer by the dispatcher and the fire-control planner.

ROTARY FIRE MOP

Philip H. Murphy

Assistant Ranger, Helena National Forest, U. S. Forest Service

This rotary fire mop is probably the only hand-operated fire-control unit that generates and applies its own flame-suppressing energy and in volume and effect simulating water under pressure. It is specially designed for the suppression of flame in grass or stubble-type fuels on relatively open fields and range, but is equally applicable to flame of this type in standing timber.



Murphy rotary mop in use (left) and close-up of mophead (right).

The device is solid and durable. With the exception of the flaps, it is of all-metal construction. No screws, bolts, or nuts are employed in its assembly; nor belts, gears, pulleys, chains, or the like that invite wear and tear. Maintenance is confined to the replacement of a flap on rare occasions. Servicing only calls for greasing of the two journal housings once annually.

How the Mop Works

The mop is easy to operate. The separate but simultaneously produced powers, obtained from tension and centrifugal force, are draft, flailing or striking, smothering or blanketing, and crushing. Flexible flaps provide a continuity of suppressive energy. The flaps are fixed to an axis so as to permit each, when in action, first to store energy in the form of tension and then to release the tension suddenly and augment its power by centrifugal force.

The rotary mop is propelled along the flame line like a lawn mower, either forward or backward, in an upside-down or right-side-up position. It converts the simple process of walking to flame-suppressing energy, and applies it directly to the fire.

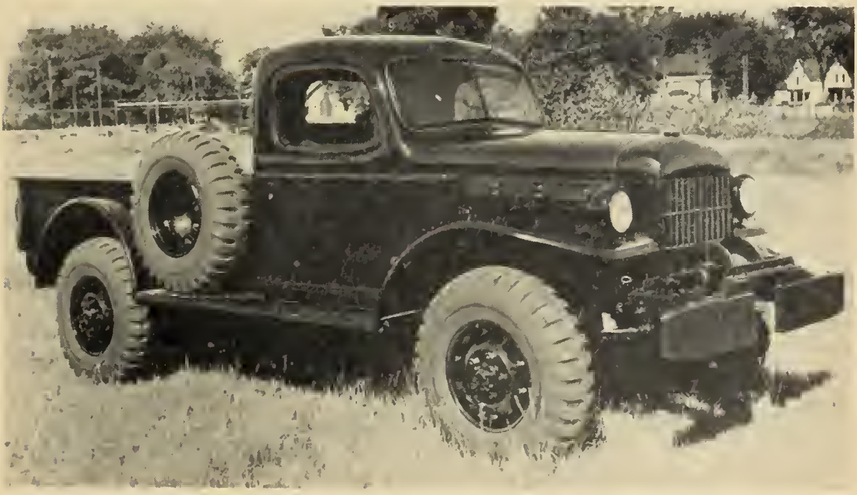
In the hands of an energetic operator it can suppress flame much faster than the conventional hand tools. Because of its caterpillar-like movement, the mop readily surmounts any obstacle equal to its own diameter. While in operation, it continually projects its own smooth tread, over which it may progress and simultaneously recover the tread after passing. The projected tread provides for its own traction and prevents skidding. Angular flap ends encourage the force of the created draft to "blow" hot ash and sparks onto the burned-over area. The tool is effective for the mop-up of punklike fuels.

Specifications

Because expansion of its principles is unlimited, no dimensional specifications apply. Model 5–15–A weighs approximately 23 pounds, and has an over-all length of about 72 inches and width of 17 inches. The 6 flaps each have a surface area of about 180 square inches, and the smothering surfaces at maximum operation are constantly at 225 square inches. Patent is pending. The cost is $24.50.

Postwar Truck.—Those who have observed military automotive equipment have been struck with the sturdiness and efficiency of the ¾-ton weapons carrier and its adaptability to fire-control work. Elsewhere in this issue appears an article on military equipment and Maj. Charles A. Rowland, the author, describes the simple conversion of the weapons carrier to a quick-attack light tanker.

The Dodge Brothers Corporation, makers of the weapons carrier, has developed a peacetime version of this vehicle and it is now in production. It is known as the 1-ton, 4 x 4, general purpose truck.



This express or pick-up type, known as Model WDX (as illustrated here) has four-wheel drive with four forward speeds, mounts a winch on the front as optional equipment and has a power take-off. Payload capacity: With 9.00 x 16 tires—3,000 pounds; with 7.50 x 16 tires—2,000 pounds.

FIGHTING FIRES WITH JEEPS

Perle Lewis

Forester, Clark National Forest, U. S. Forest Service

No piece of Army automotive equipment has been of greater interest than the jeep. The only jeep actually owned by the Forest Service during the war is the one described here. Hence it became a pilot model for adaptation to fire-control work. Observations of its characteristics and performance have applicability in every forested region.

On rough terrain the jeep has outstanding advantages over other automotive equipment. This has been demonstrated on the Clark National Forest.

A new Army jeep, assigned to the forest in the fall of 1942, has consistently enabled fire fighters to get to fires in considerably less time with resulting savings not only in acreage burned but in suppression costs.

In 2½ years, the jeep has traveled more than 21,000 miles in the more rugged part of the Ozarks, at elevations of 500 to 1,650 feet, with wide variations in topography and through timber stands that range from dense reproduction to old, mature trees. Here, veritable networks of old logging roads and skid trails exist, but are in advanced stages of disrepair. Heavy rains have transformed some of them into gullies, while others are almost obliterated by the growth of saplings. It has never been possible to keep more than a few main trails in a condition where regular trucks and pick-ups could be operated for fire protection. Moreover, the region is drained by numerous small creeks, bedded with gravel and sand and commonly crossed—except for the important roads—by fording.

Jeep Gets Them There

The jeep takes fire crews across terrain that is otherwise accessible only on foot or horseback. On one occasion, a fire was reported by radio to a stand-by crew with a pick-up, which was 2 miles nearer the fire than the jeep which left the ranger station at the same time. The jeep forded a creek and drove seven-tenths of a mile through the timber, arriving at the critical moment when the flames were beginning to eat into a field of dry sedge. The jeep crew stopped the fire—limiting it to 3 acres. The pick-up crew had to walk the seven-tenths of a mile through timber and came 15 minutes later than the jeep.

On another fire the ability of the jeep to get to the fire saved 2 hours of walking and 2 hours of crew time over that of a crew which used an ordinary dump truck for transportation.

In numerous instances the jeep, equipped with a 30- or 70-gallon tank of water, saved considerable time in the initial attack or mop-up because of the crew's ability to get the water right to the fire. Fitted with a 30-gallon tank, the jeep can carry two men, including the driver. This has been very effective in the initial attack. Using the 70-gallon tank limits the crew to the driver, an arrangement largely used for mop-up work.

Advantages of Jeep Over Pick-Up

Because of its construction, the jeep has numerous advantages over the pick-up. It can ford fairly deep streams because the breather pipe and oil filter openings are near the top of the motor block. Unless it is almost submerged, water cannot get into the crankcase. The generator is equipped with a hand latch which releases the fan belt when crossing streams, so that the fan will not throw water over the engine compartment. Streams two feet deep have been crossed easily.

The jeep can travel over rocky and rough country because it has more clearance than the regular pick-up or other fire trucks. Its construction gives the jeep more protection to the steering tie-rods and transmission than is found in ordinary equipment.

The jeep has proved equal or superior to any pick-up in economy of operation over similar roads. Finally, the absence of large fenders and cab makes it less liable to damage from brushy roads and deep ruts in cross country travel than other types of vehicles. The narrow tread enables the jeep to travel over roads with deep ruts, though not at high speeds.

Jeep Not a Cure-All

When all is said and done, the jeep is not, however, a cure-all for negotiating rough terrain. It has trouble following the contours of slopes with grades over 15 percent. On side slopes of this type, the jeep tends to slide downhill, often getting stuck between trees and other obstructions. This results in delay. However, it can make good time up and down hill on slopes of 20 to 30 percent.

The most serious drawback is the jeep's limited carrying capacity. It is rated as a quarter-ton, and under many conditions more men and equipment are needed for effective initial action than the jeep can carry. The answer to this problem seems to be the use of a larger vehicle of the jeep type, or two jeeps in the same action.

Revised Fire-Control Equipment Handbook.—A complete revision of the 1939 Forest Service Fire-Control Equipment Handbook was planned in late 1944, because of many recent improvements in (1) tools, equipment, and fire-control techniques developed by employees in the Forest Service; and (2) new types of power, transportation, and other equipment developed by the military organizations and private industries which were believed adaptable for effective use in forest-fire control. A national committee of representatives from the nine Forest Service regions in continental United States was convened at Washington, January 25, 1945. This committee discussed forest-fire control equipment needs and developments which had occurred since 1939, carefully reviewed the old handbook, and outlined plans and assignments to regions of contributions to be made, looking toward issue of a revised edition early in 1946.

During the latter months of 1945, much of the material for the revised handbook, in the form of rewrites of old descriptions and write-ups of new equipment items, has been reaching the Washington office. It is expected that all material for the revised handbook will have reached Washington and be edited and typed in the near future. The working committee designated by the national committee will thereafter convene at Washington to make a final review and arrangement of the material for delivery to the printer.

The handbook will be available to the public at the office of the Superintendent of Documents, Washington 25, D. C., at $1.25 per copy (tentative price).

SIMPLIFYING FIRE-FIGHTERS' MESS

H. M. White

Equipment Engineer, North Pacific Region, U. S. Forest Service

In recent years there has been considerable interest in simplifying the methods of feeding fire fighters. As early as 1939, concentrated rations were developed so that suppression crews on remote sectors of the control line could maintain themselves for 3 days and save hard, time-consuming travel between the fire camp and job. Meals prepared in central kitchens have been dropped from airplanes to fire crews in efforts to eliminate the delay and expense of setting up and maintaining cooking facilities at the fire. Some of these developments and experiments are described in previous issues of FIRE CONTROL NOTES.[1] Paper dishes have been used to a limited extent in order to reduce cost and overcome the danger of sickness from improperly cleansed tinware; but until recently satisfactory paper dishes were not available, and suitable disposable knives, forks, and spoons have not yet been found.

Experiments with disposable dishes and certain types of containers for dropping prepared food to fire fighters were conducted in the North Pacific Region in the summer of 1945. The results were sufficiently encouraging to warrant use of the equipment and methods on a wider scale in 1946.

Paper Dishes

In 1944 David P. Godwin made a rather extensive investigation of disposable dishes and found three articles, a partitioned plate, round utility dish or bowl, and cup with folding handle, that appeared to meet the requirements of being waterproof, heatproof, rigid, tasteless, and inexpensive. Six thousand of each item were purchased for trial on three national forests in the North Pacific Region. Descriptions and prices are as follows:

	Cost per 1,000
Chi-net 10¼-inch blue plate, code name "Lake"	$7.88
Chi-net 16-ounce round utility dish, code name "Nimble"	6.36
Flared 10-ounce cup, with handle in two parts which fold to either side for nesting	9.44

The Chi-net products were obtained from the Keyes Fiber Co., Waterville, Maine, and the cups from the C. A. Reed Co., Williamsport, Pa. The prices indicated were f. o. b. shipping point. Transportation raised the cost to slightly more than 2½ cents per single set.

A large supply of plates, utility dishes, and cups was purchased recently from Blake, Moffitt & Towne, 17 Southeast Third Avenue, Portland, Oreg., at $9.33, $7.57, and $8.07 per 1,000, respectively. Plates and utility dishes are as described above, but the cup was an 8-ounce Dixie Cup (No. 108), with the same type of folding handle as the C. A. Reed cup, and of similar quality.

Three forest supervisors reported favorably on the paper dishes, and local cooperators, who have helped on fires for years, asked why the Forest Service had not used them before. Used exclusively in lieu of tinware on several fires, the cooks, camp bosses, and firefighters also found them satisfactory. The plates and utility dishes withstood moisture and heat very well, but the cup was considered a little light, having a tendency to lose rigidity after the second or third filling.

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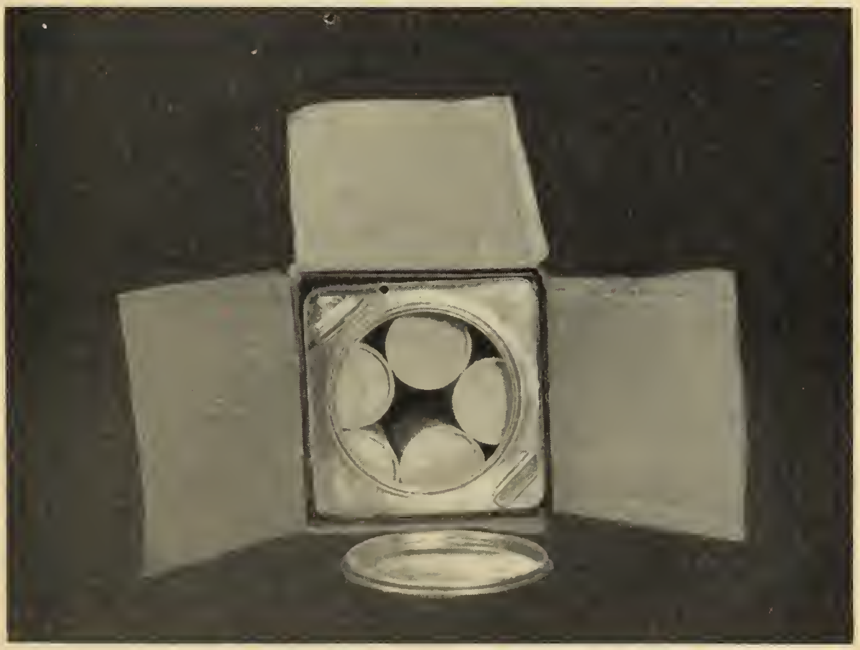
[1] April 1940, p. 49; July 1940, p. 116; January 1942, p. 22.

Paper dishes eliminate in part the cutting of wood, heating water, and hiring flunkies to wash dishes. From initial tests it is apparent that it costs less to use paper dishes than wash the usual tinware. In addition, sanitary dishes are assured at all times. An effort will be made to obtain satisfactory paper spoons and possibly forks and knives.

So far as known, paper dishes were not dropped from airplanes on any of the forests, but they obviously have an advantage over tinware for this method of delivery.

Dropping Hot Food Containers

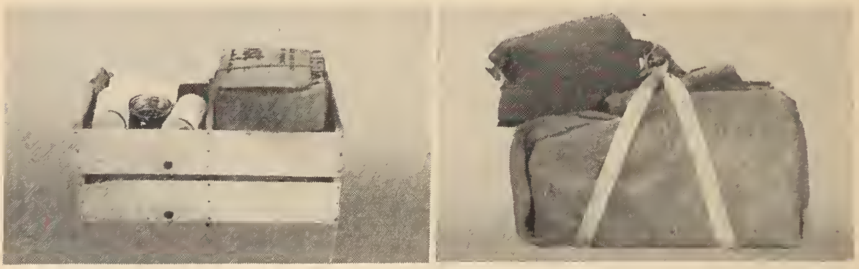
In December 1944, Floyd W. Godden, of the Intermountain Region, reported the successful use of ordinary 5-gallon gasoline cans for dropping liquids and 5-gallon friction-top honey cans for dropping prepared foods, such as scrambled eggs and bacon, cooked cereal, vegetable meat stews, etc. The cans were purchased complete with individual carboard cartons at low cost, and were left at the fire. Last spring a number of similar cans were bought in the North Pacific Region at 31 cents for the honey can and around 26 cents for the gasoline can, without cartons. Since the cartons could not be obtained, insulating and cushioning material had to be improvised.



Double-constructed carton used as insulation, 5-gallon friction-top honey can, and 1-quart cold storage locker containers. The can may be used for bulk food or to hold various foods placed in individual containers.

The honey cans were used for dropping hot meals to small crews at two fires on the Chelan National Forest. The gasoline cans were not used because a hot drink was not served, but, hot coffee or other liquid can be dropped successfully in such containers.

In one case the menu included steak, mashed potatoes and gravy, string beans, fresh milk, cinnamon rolls, and fresh fruit. While the food was being cooked the honey can, enclosed in a double-constructed cardboard carton, was set near the stove to absorb heat. The hot foods were put into 1-quart cold storage locker containers placed in the honey can in an upright position. The heated cinnamon rolls were also put in the can on top of the locker containers. The carton was then placed in one end of an orange crate, which is fitted nicely, with a 1-gallon jar of milk and fruit packed in burlap in the other end.



Left: Orange crate, with honey can in cardboard carton, and milk jar and locker containers packed in burlap. Folded burlap, not shown, was placed over the jar and locker containers. *Right:* The completed package, with parachute harness sling and silk cargo chute.

For the second fire, 4 gallons of meat balls and spaghetti in tomato sauce were put into a honey can without locker containers. The other half of the orange crate contained fresh milk, packed as before, and lettuce and tomato salad in locker containers.

In each case, the orange crate and its contents were wrapped in a piece of burlap 7 feet square and placed in a sling made of salvaged parachute harness. (The sling could have been made of rope, if parachute harness had not been available.) The packages were dropped safely with converted man parachutes. The weight of each package is not known, but undoubtedly it would have been a light load for a standard silk chute. Elapsed time in the first test was 3 hours, and in the second, 9 hours. On both occasions the cooked food was too hot for immediate consumption. There was enough meat balls and spaghetti for two meals for the crew. For the second meal the can was quickly heated over an open fire and the food was then as palatable as when freshly cooked.

In both cases, the food was dropped to smokejumpers who had individual mess kits. However, paper dishes could easily have been packed in the crate, with the milk and fruit or salad, by using less burlap packing.

THE SAND BOX AS A FIRE-CONTROL TRAINING TOOL

D. H. Euler[1]

Suppression Crew Foreman, Angeles National Forest,
U. S. Forest Service

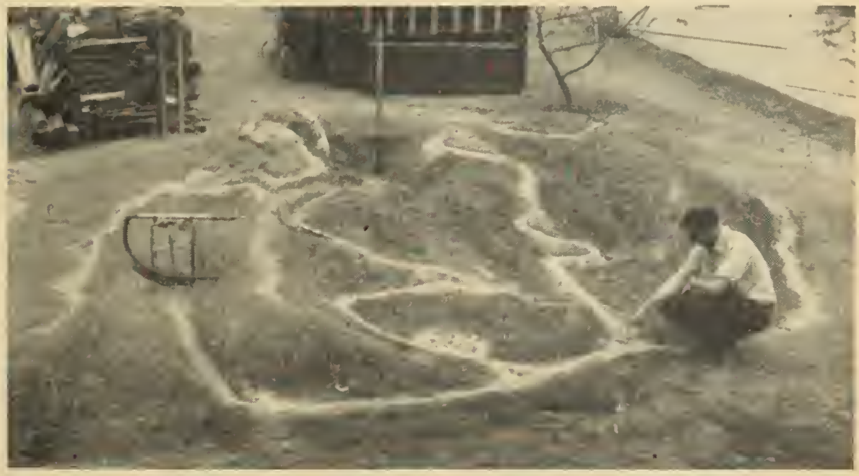
The two chief functions of the Forest Service protection force are fire prevention and fire suppression. The success or failure of our crews' performance in these functions is governed in large measure by the amount of training they get and its effectiveness.

Training in fire prevention and suppression is a technical job, and every available method and tool should be put to its fullest use. The sand table, film strips, motion pictures, and other training devices have been used effectively by the United States Army and Navy to train their personnel in the shortest time possible. Likewise in training large numbers of short-term forest protection men quickly, we have made many adaptations of new techniques to our specific purposes. Among them the sand box has proved quite successful.

The sand box is an adaptation of the Army sand table. But instead of a table holding sand for molding purposes, it is simply a mound of earth built up in the back yard of a ranger or guard station and shaped to simulate a real area with all its topographic features and various types of vegetative cover.

Angeles Sand Box

The Angeles sand box was constructed on an unused piece of ground approximately 30 feet square. Earth was piled with pick and shovel in the center and formed into every conceivable variety of ridges and



Sand box used on the Angeles National Forest to train its protection force.

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[1] Appreciation is expressed to M. W. Durham, Tom Henderson, and many others whose suggestions in developing the sand box have been of great help in training personnel in fire-suppression techniques.

Close-up of sand box showing simulated topographical features.

canyons. The result was a miniature barren, mountainous wasteland, which represented roughly one township, according to scale. Roads and trails were outlined with white sand on the hillsides—dams, tunnels, and bridges adding a realistic touch. Miniature buildings simulating lookouts, guard stations, warehouses, tool caches, and settlements were constructed and spotted into the area. The miniature buildings were small blocks of wood roughly shaped and painted, as were the lookouts, with pyramid top mounted on match sticks. A small village and public camp ground represented risk and places of fire occurrence. A flood-control dam in the canyon above the village helped bring out the importance of watershed protection.

With the sand box constructed and the culture prepared and located, some suitable fuels were required to illustrate the problems to be solved by actual burning of the cover. The fire was attacked in a safe and correct manner, bringing out points of attack; line location; and methods of control, such as direct attack, backfiring, etc. Various fuels were tried, including grass, pine needles, and light brush, with heavier brush stems to represent timber and logs. The pine needle cover was the best for burning, and dry grass most suitable for flash cover type of fuel. The shorter pine needles proved slightly better than the long needles, as the latter were "stringy" and difficult to keep off the roads and firebreaks, and added to the difficulties in teaching backfiring techniques. The heavier brush stems, simulating logs, added to the instructional value by rolling into unburned areas, smoldering after the fire had passed, and the like.

Before the sand box was used, the trainees were carefully schooled in the factors affecting rates of spread, such as relative humidity, wind, fuel moisture, temperatures, use of tools and equipment, and safety measures, in order to give them background and working knowledge of fire-control techniques. A preview of the specific problem to be worked out was given before the match was applied. Each problem was followed through from start to finish, encouraging the trainees to bring out all angles possible. After a major fire had devastated a good portion of the sand box watershed area, a fire sprinkler system was set up, the water turned on, and within a short time the erosion from a burned and an unburned area became evident.

Trainees Learn Readily

It is surprising how readily the trainees comprehend the manner in which the fire burns; the effects of various drafts; rolling materials; rates and direction of spread; and the convection of air currents created by ridges, peaks, and canyons; and other characteristics of full-sized fires. There is little hesitancy on the part of trainees to speak up when they recognize various points previously discussed in the classroom.

The problems which can be worked out on the sand box are endless. Where there is smoke, there is fire, and where there is fire the interest of the trainee is captured. Where there is interest, training is effective.

Conclusion

The development and use of the sand-box training system on the Angeles in 1944 has proven very successful and its use is encouraged and recommended. It should be stressed, however, that the sand box is not a plaything, or merely a game to pass the time away, but a definite training aid to be used in coordination with any fire-control handbook, and to study problems that have been or will be met on going fires. Further development and use of the sand box will bring improvements, and experimentation with various problems should be encouraged.

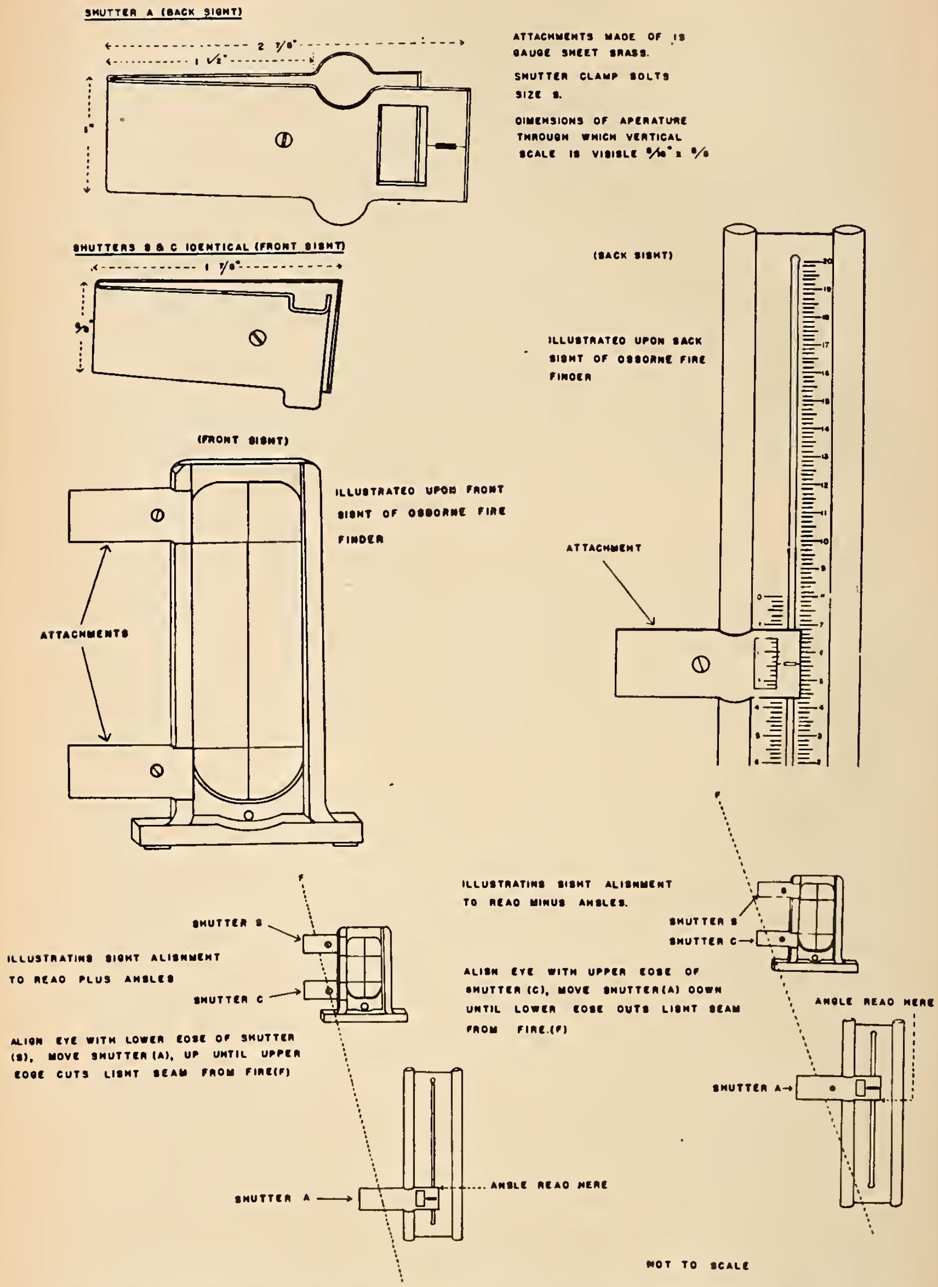
E. D. Reports.—At the meeting of the Fire Control Equipment Committee in Washington, January 1945, various forms of dissemination of equipment information were fully discussed. As a result of better organized equipment development throughout Forest Service regions, we receive, from time to time, comprehensive progress reports of items which have importance and general applicability. Because these are too lengthy and detailed to be used as articles for Fire Control Notes, the Committee recommended that they be edited and mimeographed with multilith illustrations and distributed to field agencies.

These descriptive write-ups are labeled "E. D. Reports" and bound in a distinctive orange paper cover and numbered consecutively. So far the following have been issued:

Wescoatt Plow	E. D. Report No. 1
Michigan Line Builder	E. D. Report No. 2
Slip-On Tanker	E. D. Report No. 3
Army Jeep	E. D. Report No. 4
A Kapok Bed Bundler	E. D. Report No. 5
Ranger's Pal Plow	E. D. Report No. 6
Middle-Buster Plow	E. D. Report No. 7

These seven reports have been distributed in limited quantity to the Forest Service regional offices, the State foresters, and to certain Interior Department bureaus. It is regretted that wartime paper restrictions placed such severe limitations on quantity, but the geographic distribution is such that we believe interested readers of Fire Control Notes will be able to borrow these listed reports from one of the offices mentioned without much difficulty. Later we hope to be able to get much fuller coverage in the distribution.—*Division of Fire Control, Washington Office.*

NIGHT ATTACHMENT FOR FOREST FIRE FINDERS


SHUTTER A (BACK SIGHT)
2 7/8"
1 1/2"
1"
SHUTTERS B & C IDENTICAL (FRONT SIGHT)
1 7/8"
5/8"
(FRONT SIGHT)
ILLUSTRATED UPON FRONT SIGHT OF OSBORNE FIRE FINDER
ATTACHMENTS
(BACK SIGHT)
ILLUSTRATED UPON BACK SIGHT OF OSBORNE FIRE FINDER
ATTACHMENT
F
SHUTTER B
SHUTTER C
SHUTTER A
ANGLE READ HERE
ILLUSTRATING SIGHT ALIGNMENT TO READ PLUS ANGLES
ILLUSTRATING SIGHT ALIGNMENT TO READ MINUS ANGLES.

ATTACHMENTS MADE OF 18 GAUGE SHEET BRASS.

SHUTTER CLAMP BOLTS SIZE 8.

DIMENSIONS OF APERATURE THROUGH WHICH VERTICAL SCALE IS VISIBLE 5/16" x 5/8

ALIGN EYE WITH LOWER EDGE OF SHUTTER (B), MOVE SHUTTER (A), UP UNTIL UPPER EDGE CUTS LIGHT BEAM FROM FIRE(F)

ALIGN EYE WITH UPPER EDGE OF SHUTTER (C), MOVE SHUTTER(A) DOWN UNTIL LOWER EDGE CUTS LIGHT BEAM FROM FIRE.(F)

NOT TO SCALE

The above drawings illustrate an attachment for the Osborne fire finder, designed by William Heekman, park ranger, Mount Ranier National Park, which permits more accurate readings of vertical angles on forest fires seen from a fire lookout during darkness. When using this item the observer, to determine a minus angle aligns his eye with the upper edge of the lower front shutter and moves the rear shutter down until the lower edge cuts the light beam from the fire. The plus vertical angle is obtained by using the lower edge of the upper front shutter and moving the rear shutter up to cut the light beam from the fire.

SCIENCE TRACKS DOWN WOODS BURNERS

HENRY SIPE

Assistant Supervisor, Cumberland National Forest, U. S. Forest Service

Man-caused forest fires have been increasing in many parts of the United States. The best way to prevent them is to find and punish the guilty persons. This, however, is usually not an easy matter. Skill is needed in finding evidence, following up clues, and locating the woods burner.

For example, a fire occurs in the woods, and a path runs through the burned area. The investigator or ranger must guess whether the fire was caused by a smoker, a hunter, or an incendiary. A match or cigarette left behind will not alone lead to a solution of the case. The identity of the traveler through the area when the fire started must be determined, and his connection with the blaze established. If the cause of a fire cannot be definitely ascertained, it is likely to go into the category of "unknown."

Many investigations of the causes of fires are delayed until clues have grown cold or been obliterated, because suppression of the fire has first priority. Often insufficient time is given to the investigation. A further difficulty is that the investigator is not versed in the scientific detection of evidence.

Tool Mark Clues

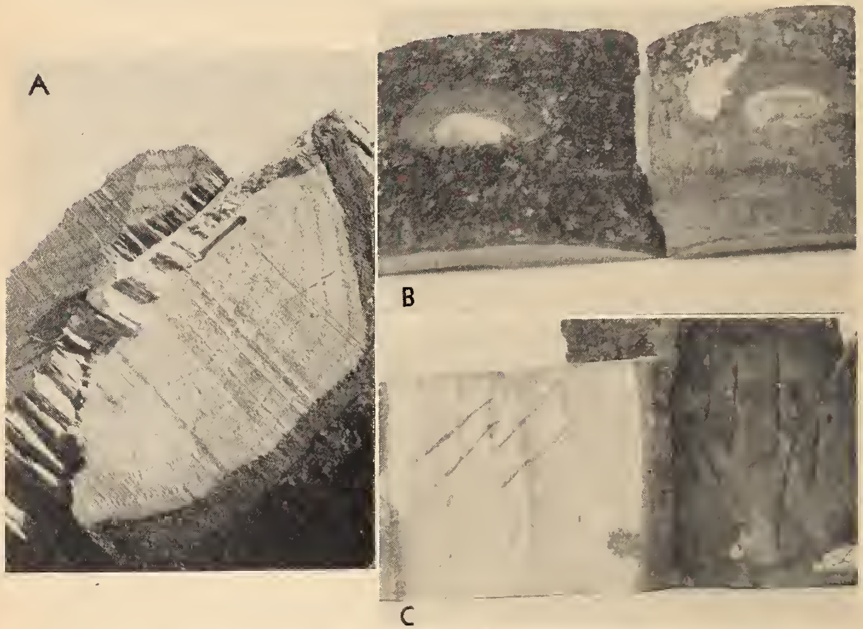
The scientific approach in determining responsibility for man-caused fires has proved quite successful on the Cumberland National Forest.

In one case, ax marks furnished the clue which led to the apprehension of a woods burner. Care must be exercised in comparing ax marks, in order to secure chips made the same way. The wood on opposite sides of a cut will differ in appearance, but close examination usually reveals certain similarities. When 10 acres of national-forest land in Estill County, Ky., were burned, a preliminary search by the fire boss failed to unearth any clues. An investigator, who arrived after dark, cross-sectioned the area thoroughly and found a moonshine still with fresh signs of a fire in the oven. Wood had been used for fuel, and ax chips showing definite nick marks were discovered. Pocketing a few chips, the investigator followed a dim trail to a house, where logs with similar marks were seen in the wood pile. Confronted with the evidence, the man of the house assumed responsibility and paid a fine. There have been no fires in that area since.

Telltale Prints

Tire, shoe, and fingerprints are among the most common and effective clues left by woods burners. A fire occurred on an old road used only by oil drillers. Tire tracks nearby showed print marks, similar to those found on a driller's truck tire. When questioned, the driller admitted being in the area the day of the fire and remembered throwing out a match near the burn. He pleaded guilty.

Another case where an ax mark provided the major clue occurred in 1943 on the Laurel district. A dead chestnut tree was found burning inside a burned area; beside it was a bundle of rags. A 6-inch hickory tree had been cut, trimmed, and used as a pry in an apparent attempt to uproot the tree; ax cuts showed identifying marks. Someone had apparently climbed a tree nearby. The investigator proceeded to the nearest residence a mile away. The man in the house said he had the flu and knew nothing of the fire except that he had seen the smoke. The investigator cut out a few chips with an ax he found at the wood pile and noted that the marks were similar to those at the fire. The man soon admitted that two boys had borrowed his ax to cut down a chestnut tree and when they returned it, had said, "We built a fire in the tree to smoke out a squirrel." The boys owned up and paid off.



A: Evidence leading to detection of a woods burner: two chips made with the same ax. *B:* Left, mark made on beech tree with suspect's mattock; right, mark found on tree on arrival at the fire. *C:* Left, cuts made with suspect's mattock; right, cuts found on burning tree.

Another type of tool-mark case occurred in 1943. Inside a burned area a large hollow beech tree was found burning. On its bark, about breast height, were marks apparently made by a blunt instrument with two kinds of edges, possibly a mattock. Footprints on a woods road, not far from the beach, led to a nearby house. The farmer living there said he and his boy had come over the road that day with a gun, mattock, and several peach tree transplants, but denied any knowledge of the fire or marks on the tree. The suspect willingly accompanied the investigators to the tree, where similar marks were made on the bark with his mattock. Sections were cut out and labeled for identification, and the farmer was told that they would be sent to the FBI Laboratory for comparison. A few days later, before a reply could be received from the laboratory, he called at the ranger's office and confessed that his son had pounded on the tree to chase out a squirrel, failed, and set it afire as a last resort.

A thorough search will usually reveal some clue. About dark, a towerman discovered a fire a few miles from his lookout, along a dead-end road. The fire crew arrived so promptly that whoever had caused the fire did not have time to get back out of the dead-end road. Fresh tire tracks led to an isolated spot in the woods where a car was hidden. Cached nearby were 800 pounds of sugar and 100 pounds of bran meal. Inquiry in a circuit clerk's office, 75 miles away, showed that the car had been registered in a fictitious name. This information and evidence found in the woods were turned over to the Alcohol Tax Unit agents, who later discovered a large still in the burned areas and made some arrests. The fire case was filed away, and the suspects were prosecuted for violation of the liquor laws.

A Lock of Singed Hair

A very unusual determination of responsibility was made after a fire on the Red River district in 1942. An alert ranger, searching carefully, found a lock of singed hair caught in the root of a stump. Horse tracks nearby led to a farmhouse, where a horse that made similar tracks was found. The owner admitted riding through the area, but denied causing the fire. The ranger obtained a lock of the suspect's hair. Both locks were sent to the FBI Laboratory, which replied that they were similar in every major respect. Confronted with this evidence, the suspect admitted he'd been drinking and had fallen off his horse, which ran home. He had lighted a fire to warm himself and when it scorched him, jumped up, bumped his head on the stump, losing some hair, and left without extinguishing the blaze. He paid a fine in the county court.

Ballistics

The science of ballistics is of frequent use to forest-fire investigators. Many fires are caused by hunters, from campfires, cigarettes, or in smoking game out of holes or trees. Often the hunter fires his gun and discards the exploded cartridge case. Every firing pin makes a distinctive mark on the cartridge.

In a burned area in Laurel County, an exploded shotgun shell was found near a tree that appeared to have sheltered wildlife of some kind. A "twist stick," used for poking into a tree hollow, lay nearby, and burned leaves in the cavity indicated that a fire had been used to smoke out game. Inquiry showed that several persons were seen in the vicinity the day of the fire. Examination of guns narrowed the suspects to the owner of a shotgun of the same gage as the shell found in the burned area. Permission was obtained to fire the gun in his presence.

Shells from this gun, along with the exploded cartridge case picked up at the fire, were sent to the FBI Laboratory. It replied that all the shells were fired from the same gun. This definitely placed the suspect in the burned area. Confronted with this evidence, he said he had been through the region several days before the fire and had shot at a rabbit. He showed the investigator a place outside the burn, where the alleged shot at a rabbit took place, but no exploded shell could be found there. Two persons, however, were located who had discovered the exploded shell soon after the blaze had started, when the odor of burned powder, they said, was so strong that not much time could have elapsed since it was fired. The case was brought to trial, but was lost because of certain technicalities.

Cigarette Packets

A simpler case followed a fire in Rowan County in 1943. Local farmers saw a blaze start about a minute after a stranger passed on horseback. A little girl saw the rider throw down a paper near the point at which an investigator found a "Kold" cigarette packet and a partly burned match. By means of various other clues, the stranger, a salesman who had traveled on horseback to visit a rural customer, was traced to his residence in a city 75 miles away. He admitted smoking "Kolds," but knew nothing of the fire. He readily agreed to settle the case, however, by pleading guilty before a United States commissioner.

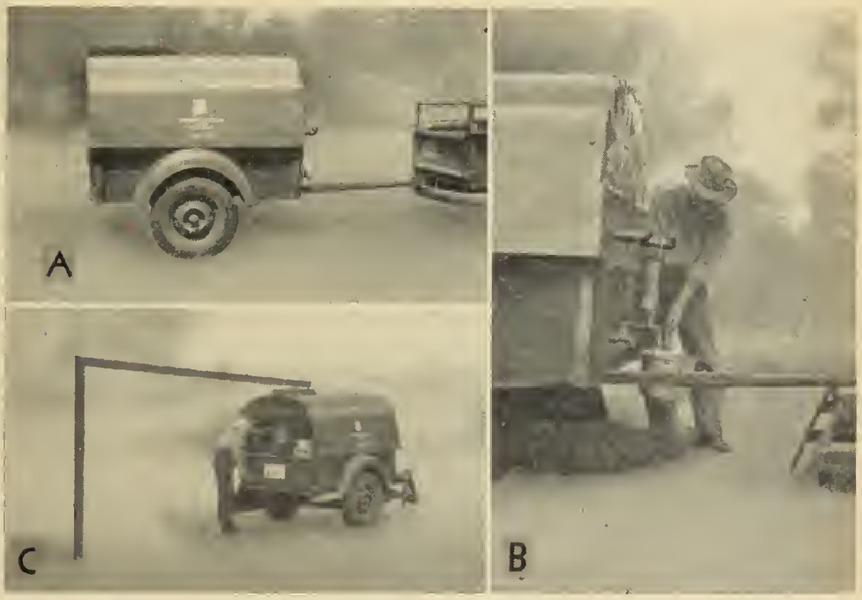
Conclusion

Our experience in tracking down woods burners has shown that the investigator need not be an FBI agent, a superman, or a trained scientist to attain the results described. He must, however, have sufficient training or experience to know what clues to look for, how to protect and preserve evidence, what significance the clues have, and where to secure expert opinion about them. With experience and a few pieces of inexpensive equipment, an investigator can often solve cases himself, without the help of experts. He must arrive on the scene before the clues are obliterated or get cold. And he must have persistence and the will to carry on in spite of obstacles.

FLORIDA CAMP TRAILER

Division of Fire Control, Southern Region, U. S. Forest Service

Mobility is a prime essential in all Coastal Plain fire fighting. Fires spread rapidly and in order to maintain a strategic position, it is frequently necessary to move the fire camp. For this purpose a mobile 25-man unit has been developed by the Florida national forests. Built as a two-wheel weatherproofed trailer, the unit is hauled behind pick-ups or larger sized trucks. This lay-out, which serves as a traveling kitchen, can be moved up to or on the fire line, a meal served, and then carried to a selected point for future use, with a minimum of moving time.



A: Side view of Florida camp trailer. Note the 2 x 4 on top, used as a rest for one end of a ridge pole. *B:* Front view of trailer and water-tank inlets and outlets. A sawhorse is used to keep trailer tongue level. *C:* Trailer set up on sawhorse with ridge pole and center post in place in preparation for making camp. Vertical peg in 2 x 4 secures ridge pole.

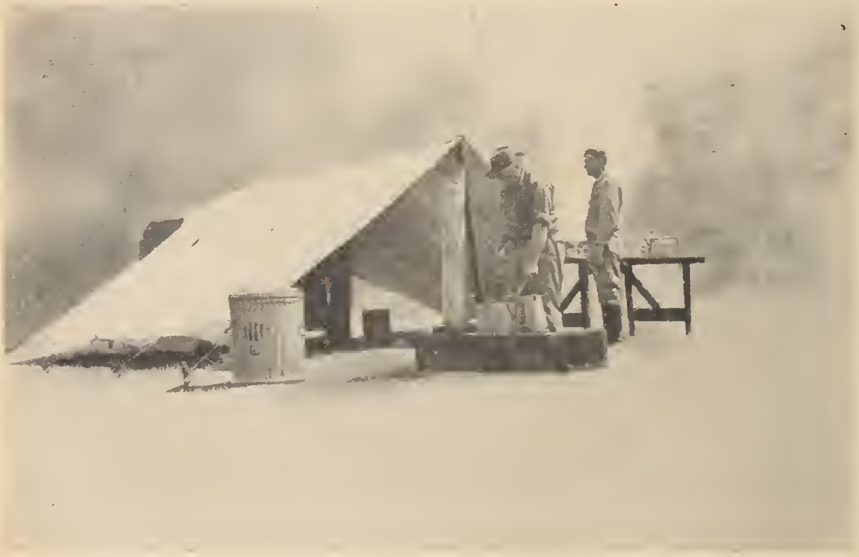
The camp trailer unit is the outgrowth of several years of experience in Coastal Plain fire fighting, and its value has been proved by successful use. It can be hauled over any woods road that a pick-up can travel. It is always kept at the central fire cache, in a ready-to-go condition.

The trailer is roofed over with galvanized sheet metal and is weatherproof. The contents are secured behind a removable end gate.

A 25-man cooking outfit and forest-built stove are standard for the outfit. Food is kept in a special food box in sufficient quantities to furnish three hot meals for 25 men in addition to Army C or K rations., A 30-gallon iron garbage can is used to heat large quantities of water over a grate or pit fire. A folding table and center post and ridge pole are regular parts of the equipment and fit inside the unit. A 10-gallon water tank, built into the trailer, is equipped with two ¾-inch water faucets and an inlet extending outside the body of the trailer at the front end.

When the tarpaulin is stretched into place over the ridge pole, a small but satisfactory shelter is provided. The trailer itself can be used as a storeroom.

Several national forests have developed similar mobile camp units with minor variations. In one instance, a small Delco light plant was built into one end of the trailer with an extension cord of sufficient length to light up the shelter, storeroom, kitchen, and immediate camp area. Such an arrangement has proven very satisfactory, as the ranger district where this trailer is used has over 100 man-caused fires per year, including many night fires.



Camp being set up, with trailer supporting ridge pole at one end.

○

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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FIRE CONTROL NOTES

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A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 7 Number 2

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire-fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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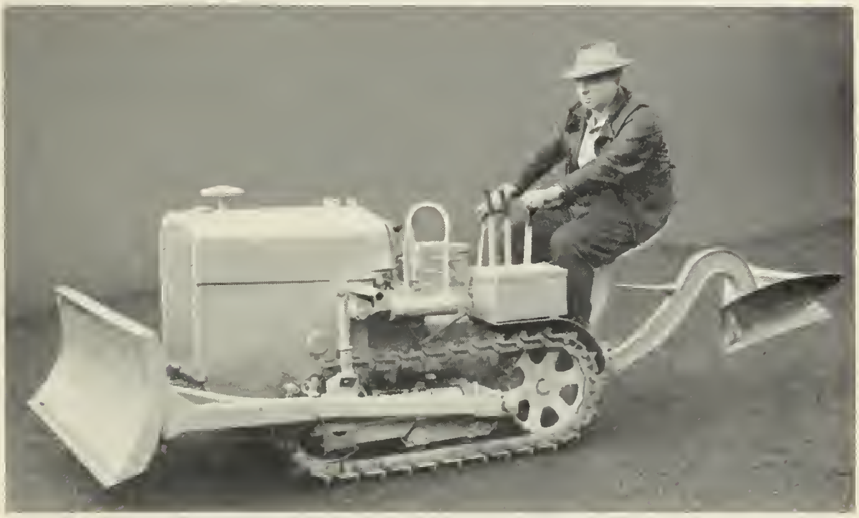
THE BEETLE TRACTOR

North Pacific Region—U. S. Forest Service

In various regions, during the past 10 or 15 years, there have been sporadic plans and trials aimed at machine maintenance of trails. On several forests in Region 6, small conventional tractors have been used to build or maintain "tractor trails." In general these turned out to be wider and more expensive both to build and maintain than the required service justified, and created drainage problems out of line with trail standards and costs.

In 1940, the Region 6 Trail Tractor was first used on heavy trail construction on the Siskiyou. It produced an excellent trail of satisfactory standard through difficult terrain at reasonable cost. The war interrupted progress on this network but work will be resumed in 1946 using the Clarkair military model developed by the Army from the original R-6 machine. Conclusions drawn from this project are that the 4,300-pound Clarkair is fully satisfactory for trail construction but larger and heavier than required for maintenance or for betterment and rehabilitation of existing trails.

As a result of experience with the 4,300-pound tractor, it was thought advisable to go to a still lighter machine for trail maintenance and betterment. In 1944 the equipment laboratory was requested to design a rugged, heavy duty unit not over 27 inches in



Wide gage beetle tractor with Wescoatt plow.

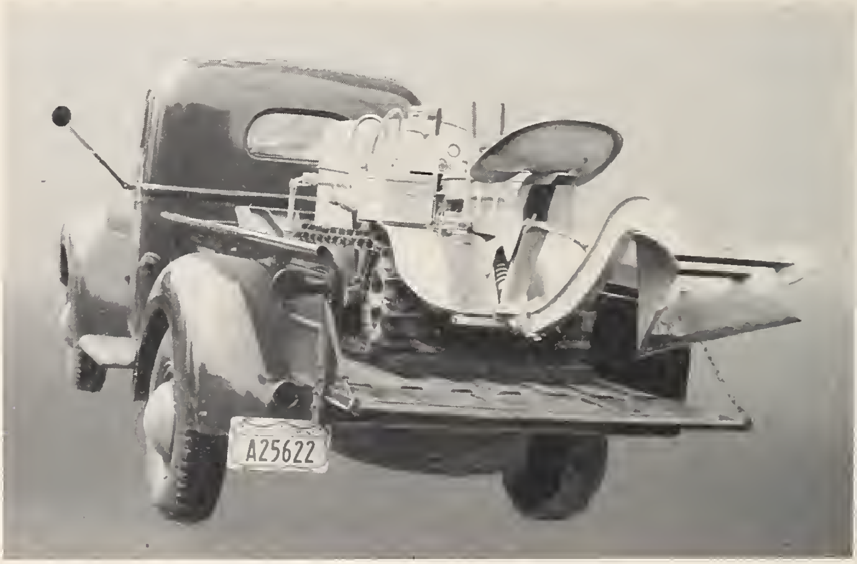
tread width, 84 inches long, with full hydraulic bulldozer, ample power, and light enough to be hauled in a pick-up. It was specified that basic tractor design should be followed insofar as practicable and commercial assemblies utilized to simplify parts procurement and repairs.

The equipment laboratory proceeded in line with the above general specifications. Design of the tractor was completed in December 1944, and plans turned over to the Portland departmental shop for fabrication. The pilot unit was finished in June, 1945. In order to differentiate it from other small machines it was christened the "Trail Beetle," which seems reasonably appropriate in view of its size and general appearance.

Beetle No. 1 was started out on the Clackamas River district of the Mount Hood. Work included removal of slough, windfalls, rocks and roots, widening narrow spots, rebuilding switchbacks to 6-foot radius, removal of puncheon and turnpiking wet spots, replacing bridges with fills, and other miscellaneous work ordinarily included in annual trail maintenance. During the course of the tests more than 20 miles of old trails were worked over and the machine was not "eased along." On the contrary, to determine weaknesses of design it was frequently put into situations beyond its capacity. Practically none developed. Results on trail rehabilitation were, in general, excellent.

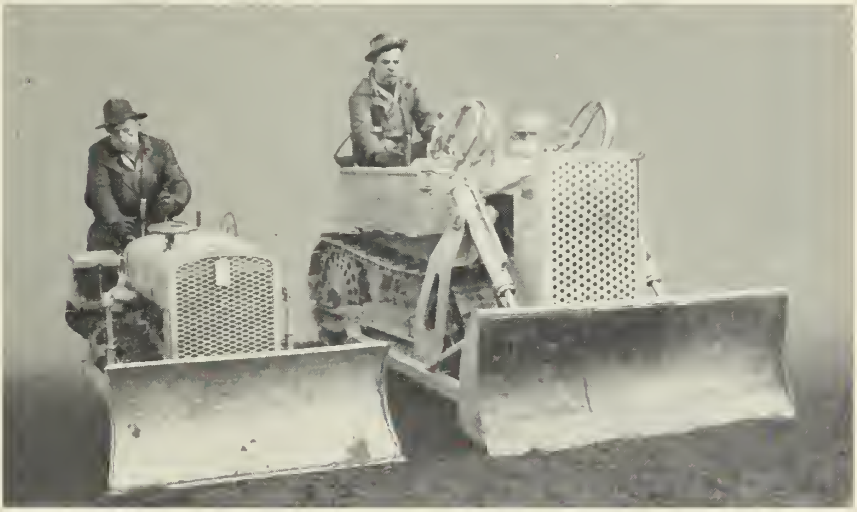
Plans are now under way for procurement from commercial sources of the beetle tractor with spare parts and it is hoped they will be available for the 1946 season.

This machine is primarily a trail worker but its small size and light weight offer fire-control possibilities in initial attack, and supplementing hand work until larger tractors can be delivered to the fire.



Wide gage beetle tractor loaded in pick-up.

Two narrow gage (27½-inch) beetle tractors are now available for use. A third, wide gage (32¾-inch) machine is undergoing tests for fire line construction. It now is equipped with a small Wescoatt plow. A disk plow will also be built and tried out behind it. In addition, it is planned to design a rotor attachment for trial use with this tractor.



Comparative size of the 1,800-pound 27½-inch gage trail beetle and 4,300-pound Clarkair.

Specification—Beetle Tractor

		Narrow gage (trail use)	*Wide gage (fire use)*
Weight, without bulldozer	pounds	1, 500	1, 530
Weight, with bulldozer	do	1, 800	1, 850
Over-all width on tracks	inches	27½	32¾
Over-all track length	do	51	51
Length of track on ground	do	36	36
Width of track plates	do	5¼	5¼
Width of bulldozer blade, straight	do	43½	50½
Width of bulldozer blade, angled	do	37	45

Over-all length with bulldozer, exclusive of seat overhang	82 inches.
Seat overhang	22 inches.
Motor, make	1 CK Waukesha, gas.
Motor, horsepower	12–14 b. hp.
Drawbar	1,600 pounds—10 hp.
Speeds, m. p. h.:	
Forward:	
First gear	1. 69
Second gear	2. 68
Third gear	4. 91
Reverse:	
First gear	2. 19
Second gear	3. 41
Third gear	5. 60
Average gasoline consumption, per hour	¾ to 1 gallon.

THE FIRE FLY PROJECT

Neal M. Rahm

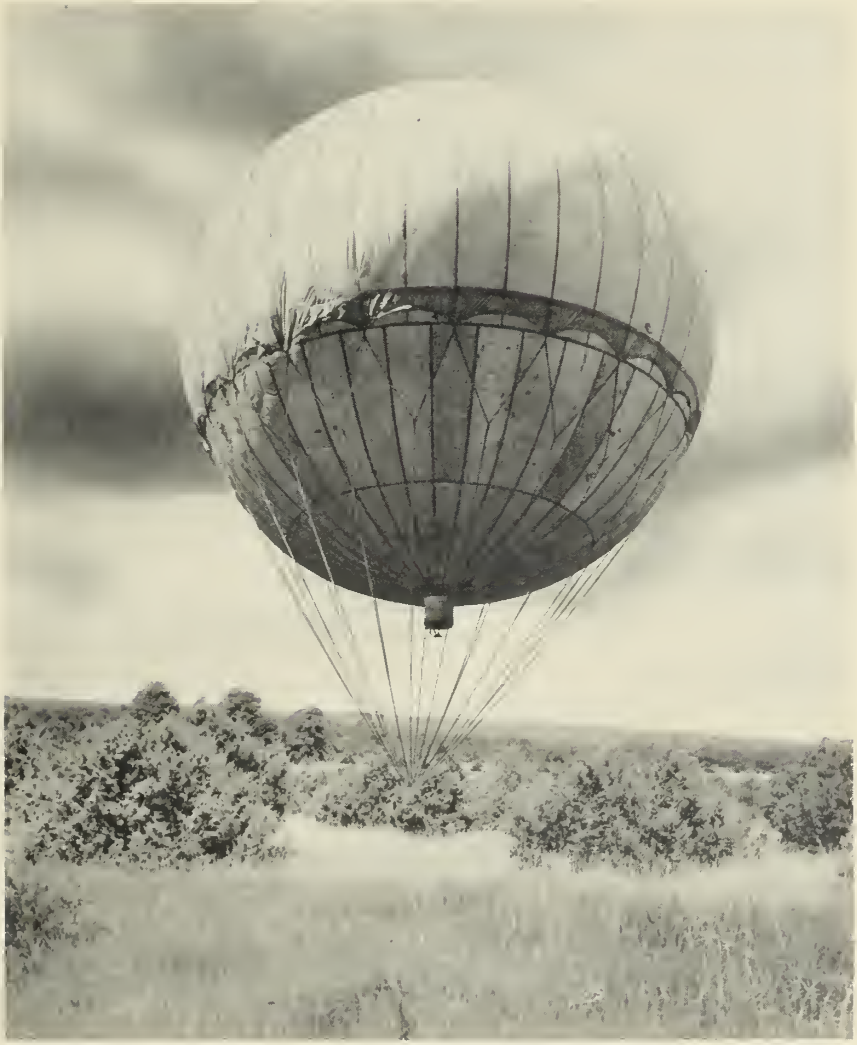
U. S. Forest Service, Liaison Officer, IV Air Force Headquarters

During the winter of 1944–45, forest supervisors and rangers in the western Regions were startled and concerned upon discovering they were actually under bombardment by enemy incendiary missiles and antipersonnel bombs. Free sailing, unmanned, paper balloons carried the bomb load which consisted of five cannisters filled with thermite and one large finned bomb containing shrapnel or three "fire pots."

District Ranger Raymond L. Beals and several inhabitants of Hayfork, a mountain town in northern California, narrowly escaped serious injury or death when the hydrogen-filled envelope of one such balloon exploded while landing in a tree. The recovered parts of this balloon and a complete unit discovered at about the same time by Supervisor Melvin E. Barron of the Modoc Forest were of vital interest to Army Intelligence. From these balloons and others recovered over a dozen western States, accurate information was rapidly assembled. They were being launched from Japan proper. Crossing the Pacific on wind currents at stratospheric levels, they reached the west coast in 80 to 120 hours. Most of the 298 recovered landed on the west coast, including Alaska, Canada, and Mexico, while a few went as far east as Michigan. An automatic device, controlled by aneroid barometers, dropped ballast and bombs.

The two objectives of the Army were rigid censorship to prevent the Japanese from learning if or how the attacks were functioning and destruction of balloons before the payloads were dropped. Censorship was remarkably successful. Leaks occurred late in the season, only when a woman and five children were killed in Oregon, and when an antipersonnel bomb exploded in an abandoned rock quarry near Santa Barbara. The Japanese, however, secured very meager information. They soon regarded the project as unsuccessful and, by April 20, 1945, abandoned the balloon attacks.

In the meantime, Federal and State agencies developed a system of detection and alerts which worked moderately well. Army air bases were kept sharp by numerous false reports. When the planet Venus became visible during daylight hours she was the target of 18 separate sorties in a single day. Experienced combat pilots claimed the balloons were difficult targets and could outfly a P–38. Near the Mexican border two Marine pilots and a salvage crew were dispatched to bring down and recover a balloon. At the first pass the pilots tried to place a short burst in certain apparatus to make the mechanism ineffective before "fanning" the envelope down with the "prop wash."



Japanese paper balloon.

They succeeded only in knocking off a few ballast sacks of sand which let the balloon rise to stratospheric levels. It was finally overtaken at an elevation of 40,000 feet where a brief burst and a blinding flash completed destruction. The explosion was so severe that the salvage party was unable to recover a single fragment.

Forest Service and other Federal and State agencies were gravely concerned. With the fire season but a few months ahead, the potentialities of the continued use of the incendiary missiles plus the possibilities of phosphorus leaflets warranted alarm. Never in the history of the Forest Service had there been such a dearth of men physically qualified to fight fire. The Washington office was requested to secure military assistance, without which the suppression problem appeared formidable. The Army was agreeable and designed a plan to provide assistance to civil agencies to combat forest fires started either by balloons or other causes. The Forest Service was designated to represent all fire protection agencies in the formulation of plans and operation of the project. Frank J. Jefferson, Assistant Regional Forester in R–5 was assigned the job of coordinator.

The Forest Service, together with the Fourth Air Force, Western Defense Command, and the Ninth Service Command devised a joint air and ground assistance plan. It was called the Fire Fly Project. It provided for troops specially trained and equipped to suppress fires. It further provided for air assistance in two forms: Reconnaissance planes and personnel to detect fires; and transport planes to carry paratroops to remote, inaccessible fires, supplies to fire fighters in such areas, and ground troops and Forest Service overhead where such transportation saved time. By May 19 the 3171st Eng. Fire Fighting Battalion (Prov.) consisting of 10 companies and 2,700 troops was organized. The 555th Inf. Paratroop Battalion consisting of 300 men was ordered for duty—200 stationed at Pendleton, Oregon, and a detachment of 100 at Chico, Calif. The First Troop Carrier Command with 7 C–47 planes was assigned the job of transporting personnel and cargo. The 161st Liaison Squadron furnished 32 L–5 and C–64 type planes and pilots for fire detection patrol flights and scouting activities.

Shortly after this activation, the State Foresters group, the National Park Service, and the United States Forest Service searched their personnel for the best training talent available. These men were thrown into one of the most intensive training tasks ever confronting fire protection agencies. The job of training 300 paratroopers, as well as 2,700 ground troops, was a real challenge. The paratroopers were given essentially the same training as the ground troops, to which was added a course in "smoke jumping"—one similar to that given regular Forest Service crews. The principal difficulty was weaning them away from Army methods which were not always adapted to our conditions. The Army used smaller chutes, dropping men rapidly from relatively low elevations and usually on flat terrain. The Derry chute developed by the Forest Service was larger, dropped more slowly, and could be guided by ropes attached to slots in the canopy. Up-drafts over rough terrain frequently held the chutes stationary in the air, or in some cases caused them to go up instead of down. This had an unnerving effect upon the colored paratroopers. In a few instances the men attempted to climb the shroud lines to determine what was holding them up.

By early July, troops had been trained and moved to their assigned camps in N. F. Regions 1, 5, 6, and 4. General areas were determined by the degree of existing potential fire hazard, and specific locations were, with one exception, at air bases of the Fourth Air Force or at camps adjacent to bases. These were picked to facilitate air movement of troops. Two fire control sections, one at Silver Lake, Wash., and the other at San Francisco, Calif., were established and representatives from the Forest Service, Ninth Service Command, First Troop Carrier Command, 161st Liaison Squadron, and the Fourth Air Force were on deck, prepared to coordinate the efforts of their commands.

Shortly after the first of July, severe lightning storms opened the fire season with a bang. A fire situation developed in Region 5 and Region 6 which at times exhausted all Fire Fly personnel in these regions. Troops were flown from Camp White, Pendleton, Spokane, and Chico to fires in Oregon, Washington, and California. All units received their baptism by fire and functioned well. During the first 2 weeks of July, the Troop Carrier Command carried 70,000 pounds of cargo and 681 men. On the Klamath Forest in California, 800 men were subsisted by aircraft; 17,000 pounds of food and equipment being parachuted to them during a single day. The disastrous Wilson River fire in the Tillamook area in Oregon started at this time and was not controlled until the early part of September. During the latter part of July, all Fire Fly personnel were withdrawn from this fire and a regiment of Army engineers took over suppression work on a project basis.

In August, two bad situations developed in California, again caused by lightning storms. These same storms aggravated existing serious fire problems in Region 6. Regions 1 and 4 also exhausted all their units at one time during the month. The fire season terminated, or was sharply reduced in Regions 1, 4, and 6 during the early part of September, but because of high winds and low humidities, serious suppression problems continued throughout September and into October in Region 5.

An innovation to our general use of parachute attacks was jumps in force. In one instance 100 troopers and full equipment were dropped as a follow-up on a 300-acre fire in the Chelan National Forest, Wash., where the initial attack by 10 Forest Service smoke jumpers failed to hold the fire. For the first time in the history of Region 6, a large fire in this inaccessible location was controlled within the first burning period. Another mass jump by 50 men was made in the rough Mount Baker area in this same region, but for the most part 6 to 12 men were jumped on single fires.

Total military effort for the four western regions amounted to 147,562 man-days of fire fighting. They suppressed or assisted in the suppression of 282 fires. The paratroopers contributed 4,012 man-days of this total and worked on 28 fires. For their share of the effort, the troop carriers dropped 178,974 pounds of cargo and transported 2,313 personnel. The Liaison Squadron reported 145 fires, 5 balloon incidents, and flew 3,905 hours on 1,978 separate sorties.

The cooperation and coordination required to make the organization function efficiently was remarkably good. The fire record of 1945 reflects the success of the organization. The Fire Fly project, with its joint control by several branches of the Army and the Forest Service, all working together toward a common objective, will remain forever unique in Forest Service history.

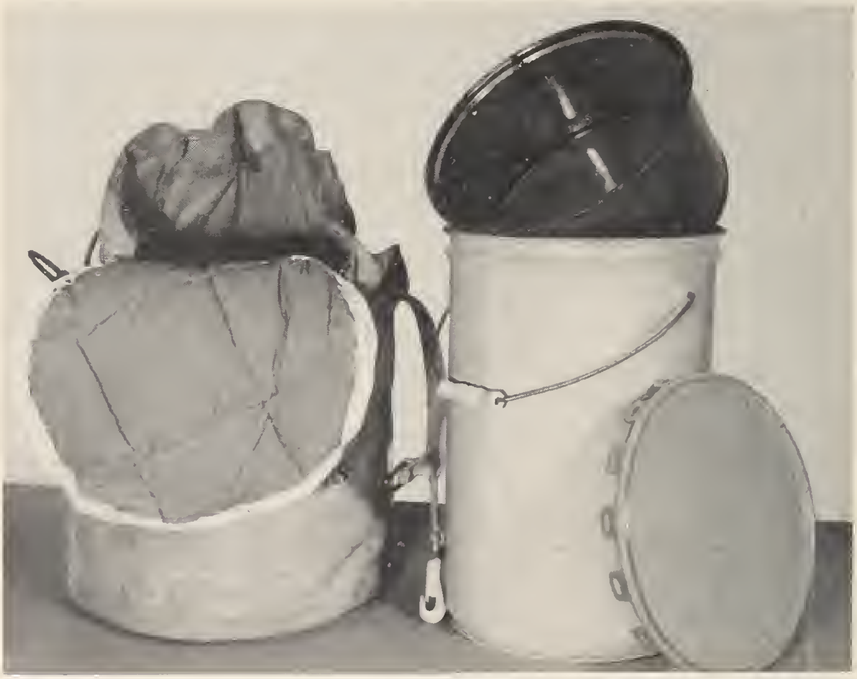
AIRPLANE DELIVERY OF HOT MEALS

RALPH S. SPACE

Northern Region, U. S. Forest Service

How many times have cooking outfits, complete with rations, cooks, and flunkies, been moved into fire camps only to serve one or two meals? When the costs of setting up a kitchen, packing in and out, cleaning up and repacking the mess outfit, and cook and flunky wages, etc., are added up, the cost per meal is enormous. In addition to these costs, time and energy have been lost hiking from the fire line to a camp for meals. Rarely is it possible to establish a camp right on the fire line. More often anywhere from 30 minutes to an hour or more have been lost hiking to and from work.

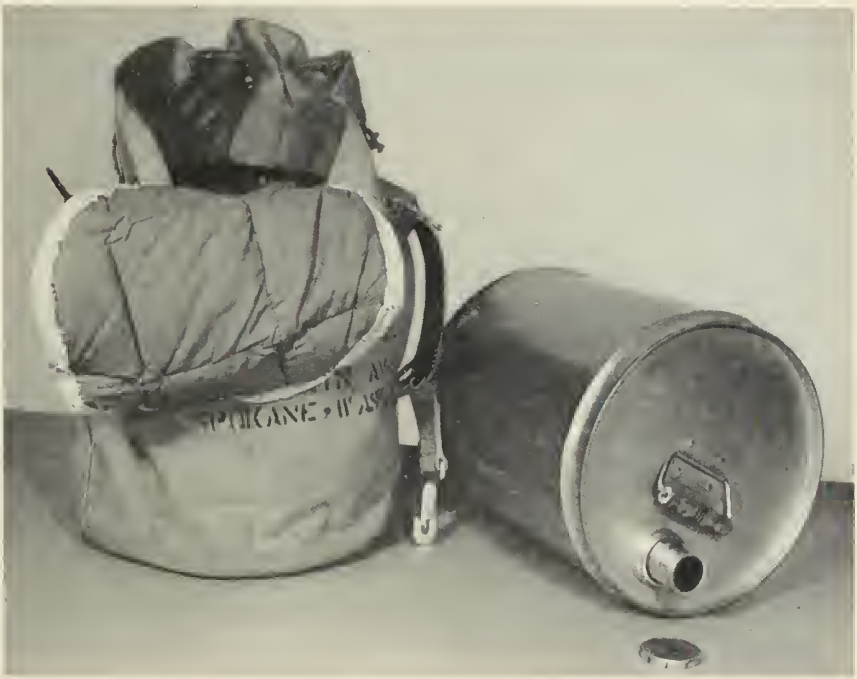
To cut losses in time and energy, in particular, and in some cases to feed fire crews more economically, Region 1 designed containers for delivery of hot food by plane and parachute. The method included the use of new inexpensive 5-gallon paint cans, enclosed in kapok cases,



Hot food container with kapok bag for insulation.

much like those in which ice cream is packed, except that each of these containers is provided with two or three compartments as needed instead of one. Food packed by this method has been kept hot 4 hours, which is ample time to fly it from Missoula to any point in the region. The over-all cost of each container unit (which includes paper dishes, paint cans, and protecting bags made from condemned kapok beds) is about $5. The unit can be abandoned in the field if the situation warrants.

Almost any type of meal can be furnished and menus are varied. For instance, a dinner may include meat—fried, roasted, or in a stew—mashed potatoes, peas, and gravy. If stew is furnished, gravy is omitted. Such a meal requires two containers of two compartments each. Hot coffee or a cold drink is furnished in the third container, which is equipped with a flexible spout. The food is prepared in a local restaurant and packed in the containers.



Hot coffee container with kapok bag for insulation.

The saving in time and energy with small crews has indicated the possibility of delivering food in such containers to crews on large fires. However, certain problems, such as how to drop the containers safely through the heavy smoke blanket that hangs over large fires each morning until about 10 a. m., will have to be worked out. For small crews, though, the economy of delivering hot meals by parachute is now well established.

In 1940 an old fire boss was sent with 25 men to control a fire on top of a fairly high peak. They started early in the morning, backpacking their tools and 1 day's rations. It was a nip-and-tuck battle and around 5 o'clock in the afternoon the fire boss radioed that he had the fire under control but did not dare leave it for the night. He also reported that they had only enough food for one meal, breakfast, and very little water. Could it be arranged to send some food by parachute so he could stay overnight and mop up the fire early the next day?

"Sure," the dispatcher replied; "what do you want?"

"Well, I am not particular. Just something to eat and drink."

"How about roast beef, mashed potatoes, gravy, peas, and coffee?"

"Huh? Oh, yeah! Sure; and you might send some ice cream."

Within 2 hours he was greatly surprised to get it all, including the ice cream.

Coated Binoculars.—The first report to reach Region 3 on the use of "coated" binoculars came from District Ranger Dean M. Earl of the Apache National Forest. Although he knew there had been quite a little discussion on the coating of optical instruments, he had seen no accounts of tests made under forest conditions. So when he received a pair of B & L 7 x 50 binoculars which had just been coated, he made a few comparisons.

In his report, Ranger Earl states that the greatest single improvement lies in their use in looking toward the sun. As long as the sun does not actually enter the image, there is almost no glare. Objects nearly in line with the sun, that are only a blur to the unaided eye, stand out sharply through these coated optics. He believes that this improvement alone is well worth the cost of coating. He says that although the coating does not screen out haze, the increase in sharpness of the image is such that the effect of haze is greatly reduced. He also says the coating increases color definition, increased depth perception makes it possible to determine smoke location more accurately, and increased light transmission makes it possible to see into shadows that you could not penetrate with uncoated optics.

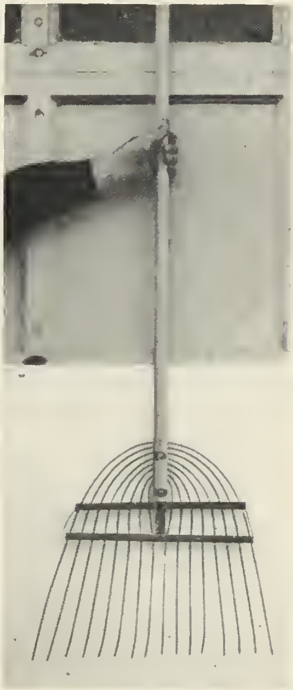
Ranger Earl believes much is to be gained in fire detection by the use of properly coated binoculars in lookout towers.

THE BROOM-RAKE FOR LINE CONSTRUCTION

Perle Lewis

Forester, Clark National Forest,
U. S. Forest Service

Every known style of broom-rake on the market has been tried on the Clark National Forest for line construction, but only one has stood up over the years under rough use. After 9 years' use on more than 9,000 fires, the simple tool illustrated on this page is still preferred over the heavier Kortick and Council tools which it replaced for fire-line raking in leaf-type fuels. Several other forests in this region also prefer this broom-rake.



Broom-rake for fire-line construction used on Clark National Forest.

Advantages

Advantages of the broom-rake are:

1. The light weight makes it less tiring to use. The simple broomlike stroke requires no back bending, and the steel tines bend over and around stones and roots instead of hanging on or moving them.
2. The tool is more effective than other rakes because the long spring tines reach between or under rocks, roots, or logs and move the leaves, twigs, and small branches down to mineral soil.
3. Line construction with the broom-rake in leaf fuel averages 6.5 chains per man-hour as against about 4 chains with heavier rakes.
4. The broom stands rough use well, although it is not as sturdy as other raking tools. The average rake can be used to construct about 160 chains of line before becoming unserviceable. However, when the average cost of constructing 160 chains of line is considered—$18 with heavier tools against $10.80 with broom-rakes—the expenditure of the 40-cent rake is amply justified.

Defects

Two defects of the rake are being studied at present. One is the weak attachment of the handle to the rake; the other is the slipping of the tines from one side of the rake to the other.

The rake shown here is manufactured by the General Hardware Co., 3618 West Pierce Street, Milwaukee, Wis.

TESTING ARMY EQUIPMENT FOR FIRE CONTROL USE

George A. MacDonald

Washington Office, U. S. Forest Service

In the fall of 1944, a committee representing the Divisions of Fire Control and Engineering and the Branches of State and Private Forestry and Research inspected the many equipment items exhibited in the depot of the Quartermaster Board and selected seventeen as possibly suitable for fire control use. Samples of these seventeen items were sent to various regions for study and testing. Following is a brief description of each item and regional comments:

Packboard

A molded plywood frame, with laced canvas back piece, web straps, hooks and lash rope. Principal advantages are: good ventilation and load distribution, no protruding side members to chafe the wearer's back or hips, and very satisfactory lash hooks. A pack bag can be attached easily if desired. Moisture does not appear to affect the plywood. This packboard is considered well adapted to Forest Service work and superior to the well-known Trapper Nelson and other canvas-lined packboards.

Signaling Mirror

A 4″ x 5″ mirror of highest quality tempered glass. At the center is a window with a small red reflector, hinged at an angle to the mirror. The "red spot" produced by the reflector enables the user, looking through the window, to line up the mirror with the target so that the flash can be seen. Region 6 tested the mirror by signaling from one lookout to another, from a smokechaser to a lookout, and from the ground to aircraft. Considered so satisfactory that the region desires 1,000 mirrors if they can be obtained at small cost.

Smoke or Dust Goggles

Region 5 found these goggles quite satisfactory where smoke or dust was troublesome.

One-Quart Collapsible Canteen

Made of plastic-impregnated fabric, encased in a canvas bag. Has plastic neck and cap. Weighs 9 ounces. Region 5 tested it with the usual treatment to which canteens are subjected and found it durable.

When empty it flattens into a very small space and the neck and cap do not become bent, as frequently happens with metal canteens. The only disadvantages are that it cannot be filled by dipping it in a stream and the material gives a peculiar taste to water.

One-Burner Cooking Outfit

A nest of three aluminum kettles, the largest being 8 inches in diameter and 4½ inches deep, a frying pan, and a small gasoline pressure burner, with collapsible legs, which nests in the smallest kettle. The outfit is compact and weighs 3 pounds. Ranger Hugh Ritter, Region 6, used one of these outfits and found that the burner had to be pumped up every few minutes, with danger of tipping over, and that in frying the heat was not sufficiently diffused to the outside of the pan. He believes the outfit practicable for use where fuel is lacking or so wet that starting a fire is difficult.

One-Gallon Collapsible Water Bag

A gourd-shaped vinylite bag. To close the bag, the long neck is folded several times and secured with a plastic strap. The bag will hold air and makes a good pillow. This article, also, was tested by Ranger Hugh Ritter, Region 6, who reported it inconvenient to handle. It should be encased in a suitable canvas bag, with carrying strap. No information as to its durability is available.

Hand Smoke Signal

A distress signal, designated Mark 1, Model O, 1½ inches in diameter and 4 inches long. Weighs 8 ounces. Emits orange-colored smoke and burns 20 seconds. Region 6 tested it in open ponderosa pine and Douglas-fir timber, with a slight breeze blowing and excellent visibility from fire lookouts and ranger station. Results were as follows:

Distance:	*Period smoke visible (seconds)*
6 miles	15
19 miles	15
16 miles	25
20 miles (field glass used)	60
11.5 miles	120
4 miles	50

From all stations, smoke could be seen approximately 100 feet above the treetops. The smoke does not last long enough to serve as an effective signal by smokechasers, and unless the air is almost still it will not rise above the timber. Region 6 also tested other Army distress signals, obtained directly from the manufacturer, and will continue tests with these large signals in 1946, in an effort to obtain suitable signals for use as test smokes, for signaling by smokechasers, and to show the location of a spot for dropping supplies from an airplane when there is a layer of smoke.

Wool Sleeping Bag

Made of single wool blanket material. Weighs 3 pounds. Has parka top and 30-inch open-end zipper. Width near top is 27 inches, and at bottom 15 inches. The cover for the wool bag is made of waterproof material and weighs 2 pounds. It has a 34-inch opening, with grommets for lacing and also snap fasteners. Region 4 considers this bag not warm enough for the higher elevations, even in summer. Region 6 says it would be a reasonably good bed for a fire fighter in warm weather, but the open-end zipper would cause trouble and the grommets and snap fasteners on the cover are not as satisfactory as an ordinary zipper.

Mountain Sleeping Bag

Regions 1, 4, and 6 received two down bags, one weighing 4 pounds 8 ounces and the other 5 pounds 6 ounces. Both have parka tops. The lighter bag is 30 inches wide near top and 15 inches wide at bottom, with a 27-inch closed-end zipper. It fits the waterproof cover described under "Wool Sleeping Bag." The heavier bag is larger and may be intended for use outside the lighter one. It has a full-length zipper.

Region 1 reported that it believes the lighter bag is equivalent to the goosedown bag purchased by the Forest Service, but will not replace the kapok bag, as it is so thin that a bough mattress is needed.

Region 4 used the lighter bag with the wool bag inside it and the waterproof cover outside. To keep warm two thickness of Army blanket and a tarp were needed. They tested the heavier bag in a metropolitan bag, with air mattresses, inside a tent. Double wool blankets were used inside the heavier bag, which was about as warm as a 4-pound wool batt. They do not consider these bags suitable for Forest Service use.

Region 6 says the casing of neither bag is down-proof and the parka tops are unsatisfactory. The 6-pound goosedown bag, as purchased in Region 6, is better. They believe, however, that with some changes these Army bags, with a waterproof cover for each size, would serve as fire fighters' beds and it might be desirable to acquire them if the price was low. One bag inside the other is considered too warm in Region 6.

Field Range, M–1937

This item was tested in Region 6 and found to be unsatisfactory for fire-camp use. Its weight of 200 pounds makes it difficult to transport and the general arrangement of cooking features is not most practical.

Gasoline Cook Outfit

This outfit for small detachments was tried out in Regions 1 and 4. The pots, pans, kettles, etc. formed the stove lids and all openings must be covered to get circulation of the heat. This was inconvenient when cooking for a small group, because the unused openings had to be covered with containers full of water. Both Regions considered the outfit not suited for forest camp use.

Tent Stove, M–1941

A round, pot-type stove of cast iron, 18 inches in diameter and 17 inches high. Regions 1 and 6 concluded that with wood available the Sibley stove now used by the Forest Service is superior.

Officers' Mess Outfit, M–1941

This 8-man outfit was tried in Regions 4, 5, and 6. The case and utensils weigh 50 pounds. Region 4 reported the unit satisfactory when 6 or more men use it. Region 5 considered the outfit unsatisfactory because the enameled ware was easily chipped and constituted unnecessary weight. All agreed that the present Forest Service aluminum mess outfits are superior.

Army Company Field Desk

This desk is a metal-bound fiber case with compartments. One side is hinged to form a writing desk. Regions 5 and 6 concluded that the company boss box we now use meets our fire-camp needs better.

Immersion Water Heater

This heater, bootlike in shape and designed to burn gasoline, was tried in Regions 5 and 6. Both Regions report the unit inferior to other units used to heat water in fire camps, such as the Portable Water Heater described in Fire Control Notes, April, 1946.

Food Containers

Regions 1 and 6 tested Army rectangular and cylindrical food containers for delivery of hot food to field crews. They concluded that insulated containers now in use on the national forests are superior and less costly. See description in Fire Control Notes, April, 1946.

Army Type Ice Creepers

These creepers were tried in Region 1 and 6 as a substitute for calked shoes. The ice creeper is an expanding metal clamp studded with seven spikes. It is attached to the shoe by webbed straps at the toe, instep, and ankle. The Regions found them burdensome to the feet and generally unsatisfactory.

FIRE PREVENTION PLANS

A. R. Cochran

Forest Supervisor, Jefferson National Forest, U. S. Forest Service

Fire prevention is one of the several ranger district activities that has many parts. These parts or jobs are like the pieces of a jigsaw puzzle. They don't make sense: all is confusion until they are put together in a plan. The relative position of any specific job is determined by the season and by the person who is responsible for it. When they are fitted together to make a plan, a picture of the whole fire prevention job on the district is obtained.

The plan gives the ranger a quick reference for current planning and shows who is responsible for what jobs at the time the jobs come up. The ranger carries his fire prevention plan in his master plan book. The supervisor finds the fire prevention plan an aid to inspection for quantity and quality of work because he has the whole picture before him and can inquire about any part to determine its status.

The fire prevention plan is produced under the Regional Fire Control Standard which requires on each district a study of the man-caused fires over the past 2 years and the preparation of specific action plans for preventing such fires. The plan consists of two parts:

A. Conclusions reached from study of occurrence records and special situations affecting fire occurrence.

B. Tentative assignment to individuals of all prevention jobs with time and place for each.

Part A, and 1 month of part B of the Holston Ranger District fire prevention plan, fiscal year 1946, are given below as a sample:

Holston District Prevention Plan, Fiscal Year 1946

Part A.

Fire Problems:

Pine Mountain Areas	5 fires annually, range burning.
Poor Valley	4 fires annually, smokers and campfires.
Currin Valley	7 fires annually, debris burning.
Sprouts Creek	3 fires annually, incendiary—since 1940—all in a high hazard area.
Konnarock and White Top areas.	These areas have had range burning fires and debris burning fires for 10 years.
N. & W. Railroad	5 miles of right-of-way.

Part B.

(1) Prevention Jobs:

Month	Job	Dispatcher hours	Top guard hours	Ranger hours
Feb.	Distribute debris burner prevention letter:			
	Prepare letter for mimeographing			2
	Determine list of addresses	2	2	
	Mail	8		
	Post contact record	2		
	Make personal debris burner contacts—Konnarock area		8	4
	Make personal contacts with specific debris burners (average of 20 per year)	4	4	4
	Contact law enforcement officers:			
	1 trial justice, 1 State policeman, 2 county wardens, 1 FBI agent, 4 game wardens		3	3
	Contact railroad officials to see if R/W hazard has been reduced		4	
	Show vocafilms to 18 graded schools		18	
	Maintain No. 1 poster display at 9 schools		6	

(2) Special Projects:

Poor Valley.—Patrolman make intensive contacts with fishermen in April and hunters in November.

White Top.—Fred Weaver contact range land owners each spring (5 days required). He will also make a special effort to "trail" the notorious Doc. Osborne.

Sprouts Creek.—Lookout A Thweatt make personal fire prevention contacts 3 days prior to each fire season. This area is noted for incendiarism.

A "SMOKE JUMPER" CREW AT WORK

Condensed from Region Four Report, by P. A. Thompson, Chief Division of Fire Control, Washington Office, U. S. Forest Service

The following is a brief account of the experiences and accomplishments of the 36-man "smoke jumper" crew stationed at McCall, Idaho, last summer. It was abstracted from a more detailed official report prepared by Region 4 of the Forest Service. It gives a good picture of the present status and potential value of aerial methods in roadless country in terms of on-the-ground experience.

In 1945 Region 4 of the Forest Service maintained at McCall, Idaho, a 36-man "smoke jumper" unit. These 36 flying firemen were trained to parachute from airplanes to fires in the forested mountains in that section of the Northwest. The area in which they parachuted to fires includes parts of three National Forest Regions, seven National Forests, and a lot of private lands. The topography varies from the flat sagebrush plains of southern Idaho to the rugged peaks and ridges of the Seven Devils in western Idaho, the Wallowa Mountains in Oregon, and the southern Bitterroots in northern Idaho. There is no more rugged terrain in the United States. It varies in elevation above sea level from 600 or 700 feet in the bottom of the Snake River Canyon to 9,000- and 10,000-foot peaks in the forests.

The crew was ready for business on July 1. Lightning fires started on July 11 and the first 2 jumps were made on a fire in the Payette National Forest. The season ended on September 16 when the last 4 jumpers walked out from the Fritzer Creek fire on the same forest. Between these dates men jumped to fires every week. Sixteen fires were handled in one busy week! The 36 smoke jumpers made 231 fire jumps on 66 fires. Of these fires 46 were suppressed by 2 jumpers; 12 fires required from 3 to 5 jumpers; 5 fires required from 6 to 10 jumpers; 3 fires required from 11 to 29 jumpers.

On August 2, 21 jumpers from McCall and 8 borrowed jumpers from Missoula parachuted to the Acorn fire. On this day the burning index was 73, which is extremely high; and winds varied from 10 to 30 miles per hour. The report states, "it was on this fire that the ground winds reinflated cargo chutes after landing and dragged 125-pound cargoes up 100 percent slopes." Nevertheless this fire was promptly controlled at less than 100 acres.

On September 2 on the Fritzer Creek fire the burning index was 85 and winds from 15 to 25 miles per hour. Six men jumped the first evening. On September 3 the burning index was 92 with increased winds. Nineteen additional men were jumped in one sector. The report states, "they alone stopped this fire on a critical 1-mile flank that was sweeping into adjacent drainages. The saving over ground crews here was probably 1,000 acres. The 25 smoke jumpers handled the most difficult one-third of this fire at one-eighth the cost." On this day 31 of the 36 smoke jumpers were out on fires. Only 5 men were held on standby for call.

This was a busy crew. Between the first fire jump and the last fire jump there was a total elapsed time of 68 days. Sixty-eight (the number of days) times 36 (the number of men) equals 2,448—the total available man-days. The 36 jumpers spent 830 days on fires which is 34 percent of the total days. But this is not all—on those 830 days the men put in 5,025 overtime hours. This is an average of 6 hours overtime for every man-day worked. A good portion of this overtime was accumulated on Saturdays and Sundays. If the regular 8-hour days worked is added to the overtime worked we get 11,665 hours or an equivalent of 1,458 8-hour days. This means that for the 9-week fire season these 36 men *worked at fire suppression* the equivalent of 60 percent of the total man-days available, Saturdays and Sundays included.

The cost section of the report is of particular interest. For purposes of comparison, reports on fires which occurred in former years in fire weather, topography, and fuel conditions comparable to the 1945 fires were studied. A total of 33 comparable fires were found—the region describes conditions as "identical" with 33 of the 1945 fires. FF costs of the comparable fires suppressed by ground forces were $92,393 *more* than the cost of fighting the 1945 fires with smoke jumpers.

The total cost of the 1945 smoke jumper operation was $23,112. The men were C. O.'s so were not paid wages. A comparable crew will cost about $60,000 in 1946 at present wage scales. It should be worth the cost for, if it makes a record comparable to that of the 1945 crew, it should save at least twice $60,000 in FF and greatly reduce area burned.

No estimate is made of forest acres saved from burning in 1945 but the size class record of the 33 comparable fires with the 1945 fires follows:

	A	*B*	*C*	*D*	*E*
1945 Actual, smoke jumper-suppressed fires	23	7	2	0	1
1937–39 "Identical" ground force-suppressed fires	10	11	7	1	4

These figures are quite significant and considered with the cost records afford pretty convincing evidence that the aerial method of transporting men to fires in remote country is good business. If the manufacturers of helicopters will just hurry up and make available satisfactory aircraft of that type, the aerial method of "getting them small" can be extended to more millions of National Forest acres.

Approximately 220 hours flying was required to transport jumpers to fires and 40 hours for training jumps.

Twenty requests for jumpers could not be met because men were not available.

There were no lost-time accidents.

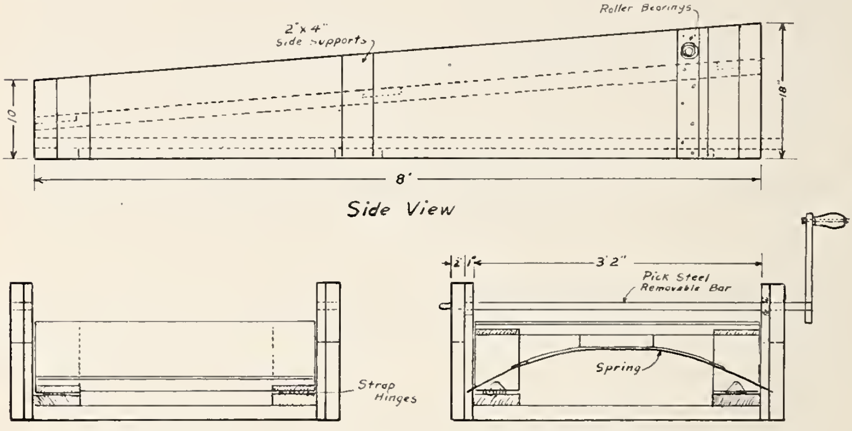
COSKI BED ROLLER

Glenn Thompson

Fire Control Staff Officer, Payette National Forest

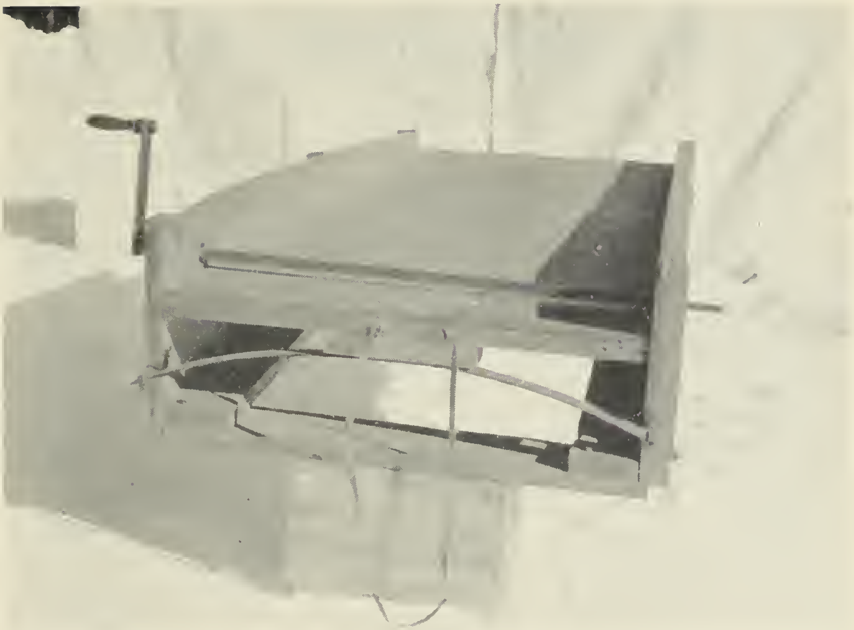
Large quantities of fire beds and bedding are cumbersome to handle and store. Hand rolling them after cleaning is a tedious, time-consuming job and in transportation, particularly by air, their bulk usually has exceeded space limits before load limits have been reached.

In 1938 when Thomas Coski, an experienced employee on the Payette National Forest, was confronted with the task of rolling 2,000 kapok fire beds for storage, he evolved the idea of a bed rolling machine which adapts the mechanical principles of friction and compression. Results were very satisfactory and the device has since resulted in great savings in time and storage space. The number of beds rolled has been increased from 10 by hand to 20 per man-hour by use of this machine. About a third more beds can now be stored in the same amount of space.



Coski Bed Roller

We use the machine for rolling all cotton, wool, and canvas materials as well as for kapok beds. The item to be rolled is spread on the platform and folded, if need be, into the desired length and width. One end of the item is then engaged around the square bar by hand and rotating is begun. The entire crankshaft assembly is pulled out after the completed roll is tied. Power rotation is now being adapted to the bed roller.



Upper end view of Coski Bed Roller with crank in place. Note position of compression spring which keeps bedding tight against roller and allows roll to increase in size.

Coski Bed Roller in use.

A PRELIMINARY SURVEY OF FACTORS OF VISIBILITY OF SMALL SMOKES IN AERIAL DETECTION[1]

William G. Morris

Pacific Northwest Forest and Range Experiment Station, Portland, Oregon

With the trial use of airplanes as the principal means of detecting forest fires on a large portion of the Chelan National Forest in Washington during 1945, numerous questions arose concerning the principles that should be followed to obtain the best detection with a given amount of flying. Factors of visibility of small smokes from lookout stations have been previously studied and reported. The results of these previous studies were demonstrated and tested in September 1945 on the Chelan National Forest to show how they apply to aerial detection of small smokes.

As indicated by these previous studies two of the important factors which apply to the visibility of small smokes from airplanes are brightness or color of the background and angle between the lines of sight from the observer to the smoke and from the observer to the sun. Visibility of white smoke in full sunlight against dark backgrounds decreases gradually as this angle increases. Against a mottled background visibility is about the same as against a dark background for angles from 0 to 70° from the sun but the visibility decreases rapidly as the angle increases beyond 70°; against a light background the visibility is less and the optimum angle from the sun is about 40°. From this optimum the visibility decreases rapidly as the angle increases.

On first thought it may seem contrary to experience that a smoke as indicated above is more visible when looking toward the sun than when looking away from it. A person usually thinks of visibility in terms of common objects such as ridges and trees, which are less visible when looking toward the sun. The opposite is true of smoke.

This greater visibility of smoke looking toward the sun applies only to smokes in full sunlight. For all practical purposes the safe visibility distances of smokes in shadows when looking toward the sun is zero. When looking away from the sun the visibility is better but is still considerably less than if the smoke were in sunlight instead of in shadow.

When looking away from the sun smokes can be seen farther on a cloudy day than on a clear day, especially if looking toward a light background. On a clear day, the visibility is greatest when looking toward the sun unless the smoke is in a shadow. On a cloudy day the visibility distance when looking away from the sun is the same as when looking toward the sun.

The greater visibility of smoke in sunlight on clear days would indicate that under such conditions a plane flying low would afford a better chance to see a small smoke than if it were flying high, because the angle between the lines of sight from the observer to the smoke and to the sun would be smaller. The facts concerning visibility of smokes on cloudy days would indicate that the plane could fly up or down either side of a drainage and have an equal chance to see a small smoke. On a clear day the side of the drainage from which the observer is looking most nearly toward the sun would afford the best chance of detection. In early morning or late afternoon, when there are shadows on the steep slopes, the chance of detecting a small smoke will be much less than during midday; thus, the patrol flights should be scheduled when there are no shadows on the hills. Broken clouds that cast deep shadows will also reduce the chance of detection.

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[1] Condensed slightly from the full article, containing references, which may be obtained from the Pacific Northwest Forest and Range Experiment Station, U. S. Courthouse, Portland 5, Oreg.

Two series of tests were made. Test-smoke bombs or smoke candles were burned under various conditions of haze, position of the sun, and background, and their visibility was recorded from different positions and elevations by an observor in an airplane.

In the first series of tests, smoke candles were ignited one after another on the airport field to provide a continuous flow of smoke while the observation plane circling above gradually increased the radius of its circle to 5 miles from the airport and at the same time climbed to an elevation 14,000 feet above the airport. The observer made notes of the appearance of the smoke at frequent intervals and gave the position of the plane relative to the smoke and the sun from 9:45 a. m. to 11:20 a. m. The wind was very light but there was considerable drift of the smoke more or less horizontally. The sky was clear but the observer in the airplane was looking down into a haze layer which was rather dense in the valleys. The background for the test smoke was yellowish gray formed by gray gravel and a sparse stand of dead grass. The haze decreased with increasing elevation and the upper limit of it as seen from the airplane appeared to be at 10,000 feet above the ground.

The airplane observer made the following notes concerning the visibility of the smoke:

Horizontal distance of smoke	Elevation of airplane above smoke	Notes on visibility of smoke column compared to approximate horizontal angle between line of sight to smoke and to sun
Miles	*Feet*	
1	700	Clearly visible at all angles.
1	1, 100	Difficult to see with sun at observer's back.
2	1, 300	Clearly visible toward the sun and satisfactorily visible at right angles to sun.
3	1, 700	Visible toward the sun and at right angles but barely distinguishable with sun at back.
5	4, 000	Not distinguishable with sun at back.
5	5, 000–6, 000	Not distinguishable with sun in the 90° sector at observer's back.
5	6, 600	Not distinguishable when sun in the 120° sector at observer's back and on the border line of visibility the shadow of smoke becomes visible before the smoke itself.
5	7, 000	Identification of smoke not certain when sun slightly behind observer.
5	9, 000	Neither smoke nor shadow discernible when sun at observer's back.
5	10, 000–14, 000	Barely seen when sun slightly behind observer but satisfactorily visible when horizontal angle between sun and line of sight about 45°. Most visible when horizontal angle 0°.

The second series of tests was made to determine the effect of several visibility factors and also to determine whether an observer looking for smokes but not knowing where they might occur would miss some of them when they are no larger than the test smokes used here. The smoke from the test-smoke candle is approximately equivalent to that produced by 200 square feet of burning Douglas-fir duff and continues to issue for 4 minutes. The test smokes were set off during a 2-hour period at unscheduled times and places in a steep forested valley 16 miles long and 5 miles wide while the observation plane patrolled above, the observer knowing that test smokes would be set off. Only one candle was set off at each place. The day was clear but there was considerable haze. The visibility distance measured with the Byram hazemeter was 11 miles looking toward dark timbered backgrounds of ponderosa pine, Douglas fir, and larch. The airplane flew at 3,000 to 3,500 feet above the bottom of the valley.

Seven out of 14 smokes were discovered. Those discovered were set under the following condition: One was in dense, tall timber, 2 were in moderately dense timber, 1 was in a patch of saplings, and 3 were on gray rock-covered ground. Those missed were as follows: One in moderately dense timber, 1 among scattered trees, 2 on the shady sides of small opening, 1 in a patch of saplings, and 2 on gray rock-covered ground. The smokes that were discovered appeared as thin wisps at some moments and as rather dense columns at others. On circling them they became less visible when the sun was at the observer's back.

During both series of tests the haze cutters developed by G. M. Byram were tried frequently. The dark red filter made the small, thin smokes examined, including that from one campfire, considerably less visible but improved the visibility of landscape features. The polarized smoked glass filter had no apparent effect on smoke visibility but improved landscape visibility.

The two series of tests substantiated the previous conclusions concerning brightness or color of background and the angle between lines of sight from the observer to the smoke and from the observer to the sun.

Several general observations of factors concerning aerial detection based on the first season of experience by pilot Gene Dolman and observer George Honey should also be mentioned. They state that about 1,000 feet above the ground is the best elevation when searching for small smokes. They believe it is impracticable for one plane to search large areas such as several hundred thousand acres for small smokes like the smoke candles. If it were suspected that small smokes, such as those from small lightning fires, were in the area a time-consuming, detailed search would be necessary. They believe the scanning method of using the eyes is better than the fixed direction or detailed examination method. Their experience indicates that the contrast of the smoke against the background will be detected at a glance and that prolonged looking at the same spot would not greatly improve the chance of detection but would exhaust the observer.

These men think that a great deal more area can be covered in a shorter time by fling across the canyons rather than up and down them. The value of this choice would depend on the size of smoke, the chance of periodic appearance and disappearance of the smoke, the lighting and background positions, and the period of visibility while a canyon was being crossed.

Several inherent characteristics of the northern Cascade Range country in Washington make aerial detection of small fires very difficult. In the higher mountains the exceedingly steep, rocky slopes and the variable directions of the drainages make only the uppermost slopes and the tops of the ridges visible to an airplane in search of small smokes unless each drainage is flown separately. A greater percentage of the area is visible in the more rounded topography and more regular drainages of the foothills. Another difficulty of detection in the higher mountains is the background color and lighting pattern. The timber occurs in patches and as scattered trees which give a mottled color and shadow pattern. Many of the higher ridges are bare granite which forms a light background from numerous angles of observation of smokes rising from the timbered gulleys and slopes below.

Inventory of State Fire Control Equipment.—A combined inventory as of July 1945 shows that the 42 States engaged in Clark-McNary cooperative protection of 301,228,000 acres of State and privately owned forests are using the following major equipment items:

Steel and stone lookout towers	1, 867
Wooden lookout towers	546
Tree lookout cabs	105
Miles protection roads	33, 710
Miles metallic telephone lines	22, 137
Miles ground telephone lines	17, 992
Tanker trucks	1, 379
Transportation trucks	1, 521
Tractors	486
Graders, bulldozers, and trailers	219
Mechanized plows	380
Portable power pumps	1, 296
State-owned airplanes	5
Radios	2, 172

The States of Maine, New York, New Jersey, Rhode Island, and Texas own and operate their own airplanes for fire control, but many other States use airplanes but on a contractual basis for similar purposes. Thirty-four States use radio in varying degrees.

McLEOD TOOL DEVELOPMENTS

Lloyd A. Qualls

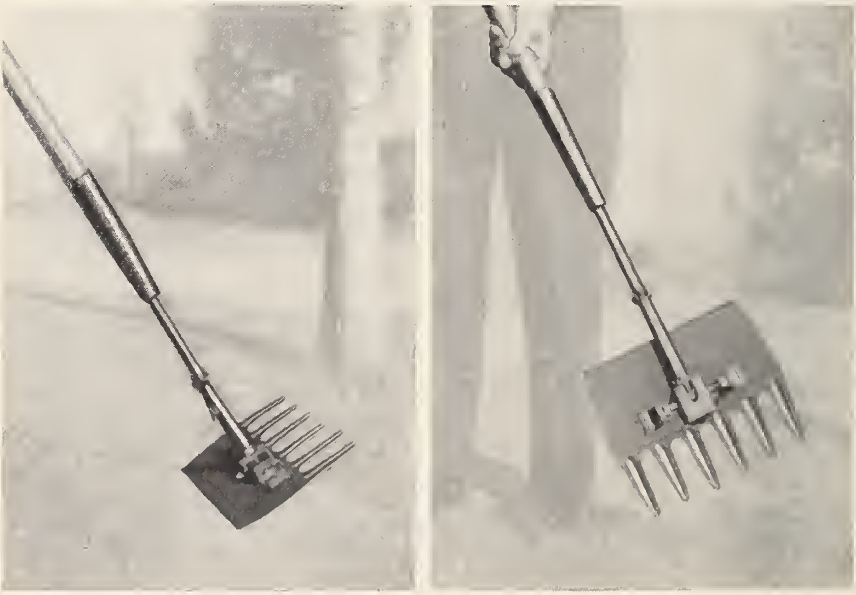
Equipment Operator, Trinity National Forest, U. S. Forest Service

Folding McLeod

The purpose in developing a McLeod tool with folding blade was to adapt the tool for more convenient packing, yet keep it in one piece.

A Kortick-McLeod was used. The triangular head of the shank was cut off and threads run up the desired length of the shank. The pipe sleeve, with keeper welded on, was slipped on the shank and the bolt used for a hinge pin welded across the end of the shank. This bolt is threaded on both ends, as the added area of the nuts on each end of the hinge pin is desirable for welding. To the nuts on the end of the hinge pins angle irons are welded and these in turn are welded to the blade. The slot cut in the channel iron is just wide enough to allow the shank to pass freely when the handle is raised or lowered. The channel iron is then welded to the blade.

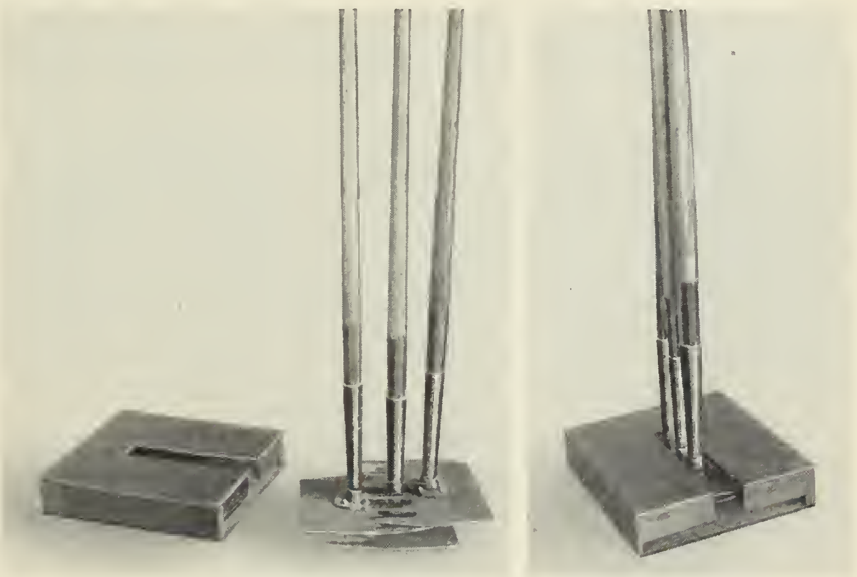
Changing over the tool adds a half pound to the weight, but less than one-fourth of a minute is required to change from the folded to the use position.



Folding McLeod tool—left, use position; right, showing folding device.

McLeod Tool Box

The McLeod tool box is made to hold three McLeod tools. Light, simple in construction, it does not use hinges, hooks, or lock pins of any kind. Inside measure is 2⅜ inches deep, 11 inches wide, and 13½ inches long. The top and bottom are of ¼-inch 3 ply. Sides and ends are made of ¾-inch material. The top has a slot 2 inches wide by 10 inches deep. The front end is made of two pieces 4½ x 1½ x ¾ inches. These are nailed to the top plywood, allowing for a 2-inch opening to match the top opening, and also providing an opening across the bottom of the front end.



McLeod tool box—left, tools and box; right, final assembly.

The tools are placed in the box one at a time, with the final assembly as shown in the photograph. Thus, the blade of the last tool in the box is held against the solid part of the front end, holding all tools in place. The handles are bound together toward the top with binder twine or rubber bands.

Combination Pulaski-McLeod

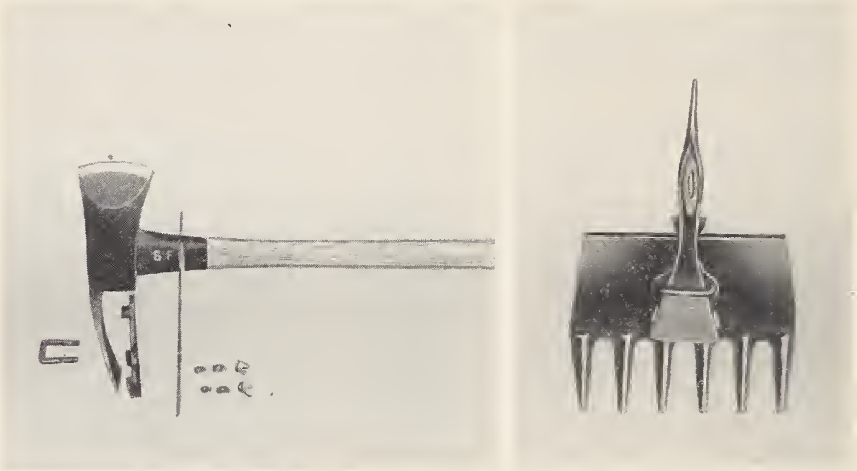
The head of a detachable McLeod tool can be attached to a Pulaski tool, thus enabling a fire fighter to carry a 4-purpose tool conveniently. The McLeod head can be carried easily in a sheath or pack and attached to the Pulaski in a few seconds.

The following are needed to make the attachment:

One **U**-bolt, ⅜-inch stock threaded both ends, bent to fit ⅜-inch holes centered 2⅜ inches apart;

Wing nuts and washers for the **U**-bolt; two ⅜-inch holes should be bored in the tool head directly under the existing holes on the cutting blade side, the hole centers to be 1⅜ inches from the center of the existing holes. The distance between the centers of the new holes should be 2⅜ inches;

An angle attachment—a piece of ¼-inch iron or steel triangular in shape. The small end has two prongs which fit snugly alongside the hammer end of the Pulaski to prevent side play. A piece of ½-inch iron is spot-welded to the main piece of metal, just below the crotch of the pronged end or "fork," giving the attached McLeod head the proper angle. At the widest or flared end of the attachment two pieces of ⅛-inch metal are spot-welded. The edges of these ⅛-inch metal "sideboards" rise about ⅜-inch above the flat surface of the attachment and act as side guides to insure against side play. The flared end at the widest point is 3 inches. The holes, as shown by the picture, are 2⅜ inches apart and act as the other side of the U-bolt clamp. The distance from the widest part of the attachment to a line drawn between the centers of the holes is 1¾ inches. The distance from the base edge to the crotch of the fork is 4¼ inches.



Combination Pulaski-McLeod tool—left, unassembled parts; right, assembled and ready for use.

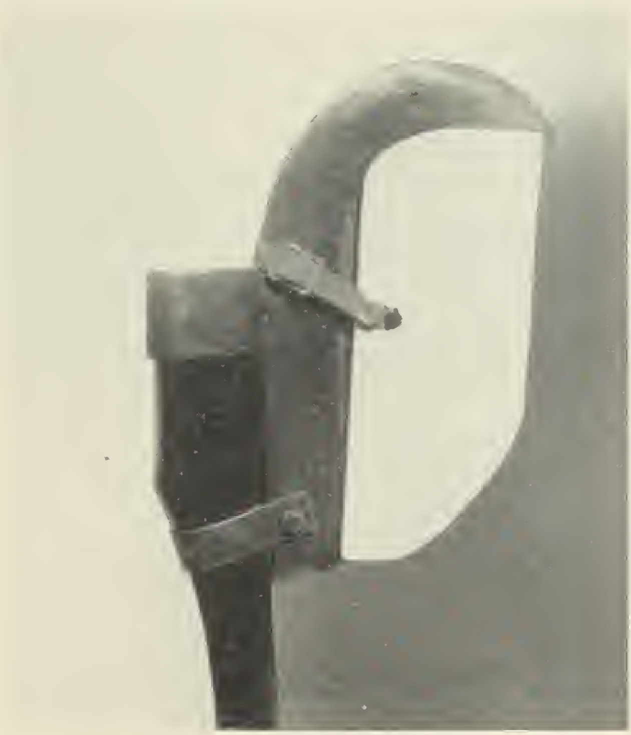
This attachment can be lightened by cutting out the center or by using a lighter gage stainless steel.

SHEATH FOR BRUSH HOOKS

HENRY SIPE

Assistant Supervisor, Cumberland National Forest,
U. S. Forest Service

Many fire-control workers are required to carry single-edged brush hooks in their cars or other places where it is not possible to keep them in a protective slot. The sharp edge of the tool is likely to be dulled by contact with hard objects or may damage softer materials.

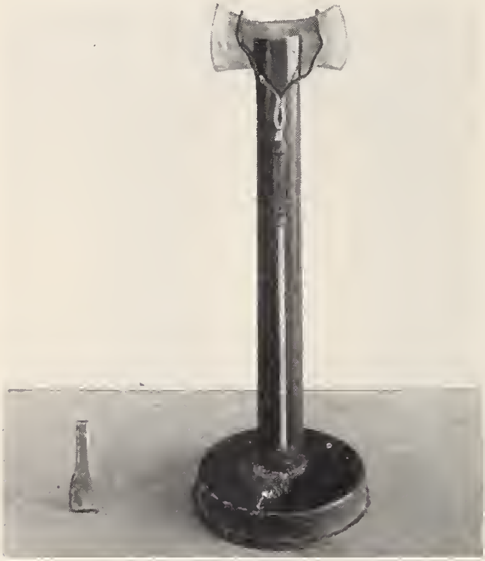


Sheath for brush hooks.

Not the least danger is the cutting of a shoe or finger. The author has never seen a commercial sheath on the market to protect the edges of these tools.

An effective and inexpensive sheath for a brush hook can easily be made by using material available to anyone. (See accompanying picture). Select a board about ¾ inch thick and as long and wide as the cutting edge of the tool. Lay the tool on the board so that the edge and most of the shoulder of the blade is over the edge of the board. Then draw a pencil line on the wood along the blade's edge. Next saw a slot in the middle of the edge of the board as far as the pencil line. This slot may be widened with a sharp knife, file, or rasp, so that the tool edge will fit snugly. A hole should then be drilled through the board at such a point that a cord or strap can be inserted and tied around the blade to keep the sheath tightly fastened. The corners of the board can be rounded as desired.

Brush hooks commonly have various head or blade shapes and sizes. It is thus desirable and easy to make each sheath fit the particular tool it is designed to protect. A little sawing and filing will usually change the sheath to fit a tool of different shape.



Holder for dehandling axes, showing ax head in slot at top of pipe.

Holder for Dehandling Axes.—This implement is made of 2½-inch wrought steel water pipe welded to any base having sufficient area and weight, such as a truck brake drum or cat-track roller, to keep the holder vertical and prevent it from jumping. The finished height of pipe and base should be approximately the same as that of a workbench. A slot is cut in the top of the pipe on opposite sides about 2½ inches deep and wide enough to allow the ax head to drop in. The slot should be slightly V-shaped with the vertex rounded or squared.

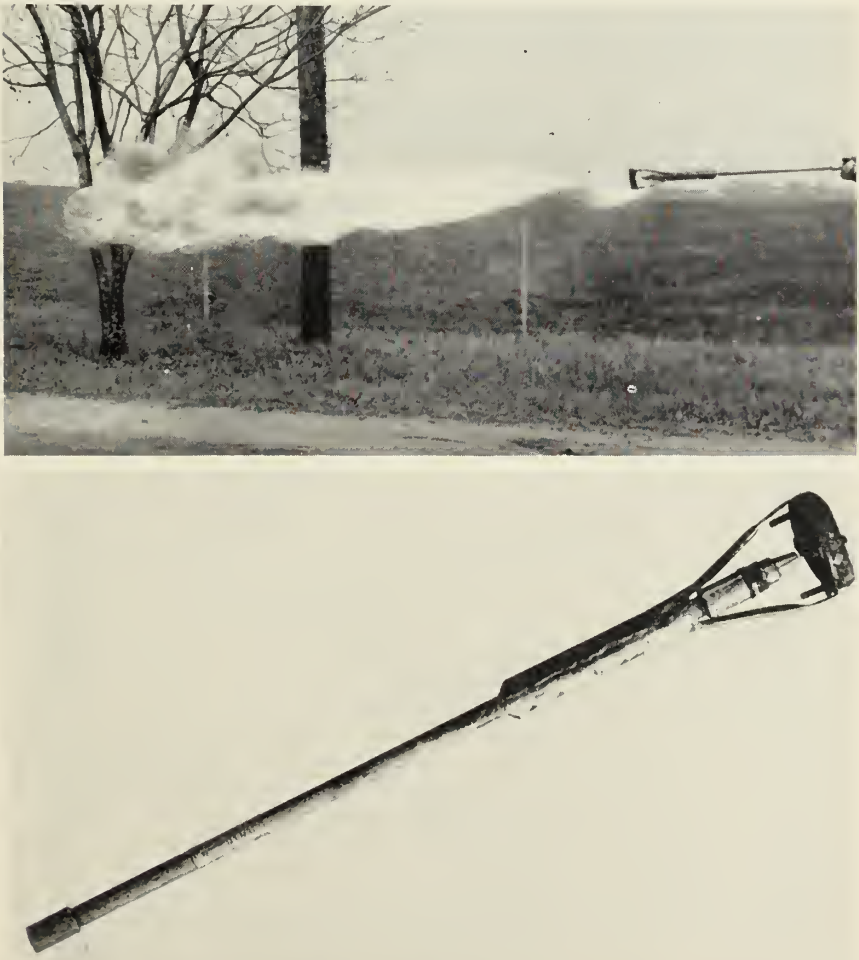
To remove the old handle, saw it off as close to the head as possible without running the saw against the ax—½ inch to 2 inches is a convenient length. Place the ax head in the holder with the wedges down. Use a handle knockout and hammer of about single-jack weight. It is not necessary to remove the wedges or drill holes. The shoulder of the handle does not need to be removed as the wood shears off readily without injury to the ax. A very tightly fitted handle can be removed in less than 1 minute.—Lloyd A. Qualls, Trinity National Forest, U. S. Forest Service.

NORTH CAROLINA FLAME THROWER

M. M. CARSTARPHEN

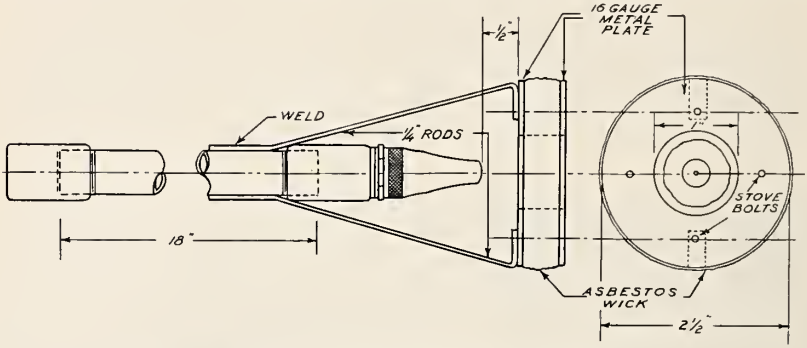
Acting District Forester, North Carolina Forest Service

The North Carolina Forest Service has developed an improved flame-thrower attachment for back-pack pumps. Its main feature is a flat disk asbestos wick with a 1-inch hole in the center, through which the kerosene fuel must pass. The circular flame of the wick insures positive, continuous ignition of the discharged fuel, a highly desirable feature.



Upper, North Carolina flame thrower in action; lower, construction details. (Photographs courtesy North Carolina Forest Service.)

The attachment consists of an 18-inch x ⅜-inch pipe extension tipped with a D. B. Smith Co. flame-thrower nozzle. A circular asbestos wick (2½ inches diameter, ½-inch thick, and with a 1-inch hole in the center) is mounted ½ inch in front of the nozzle tip. The wick is bolted between two 16-gage metal disks and held in position ½ inch in front of the nozzle by two ¼-inch rods welded to the pipe back of the nozzle. The ends of the rods are flattened and bent in ½ inch and have ⅛-inch holes drilled so that the circular wick can be bolted to them. Details of construction are shown in photograph and drawing.



Plan for making flame-thrower attachment for back-pack pumps.

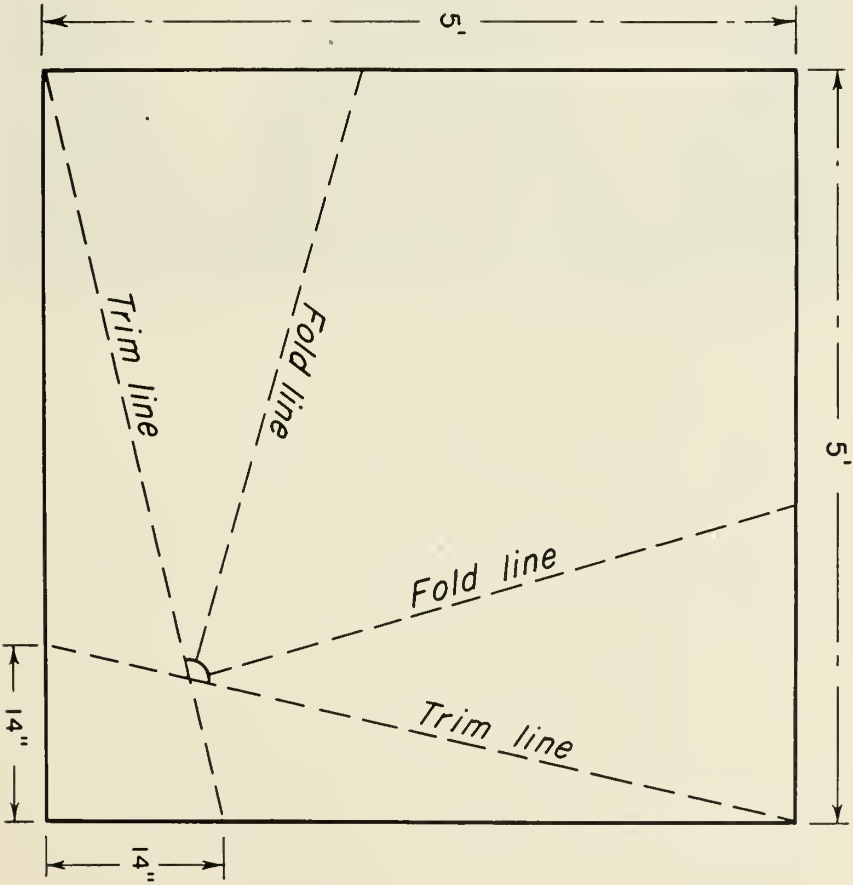
Some difficulty has been experienced in keeping the wick saturated during use of the flame thrower. But this can be overcome by placing the wick disk flat on the ground and permitting the kerosene fuel to fill up the center hole. However, a better method of keeping the wick saturated is needed.

CANVAS GRAVITY INTAKE

Curtis E. Price

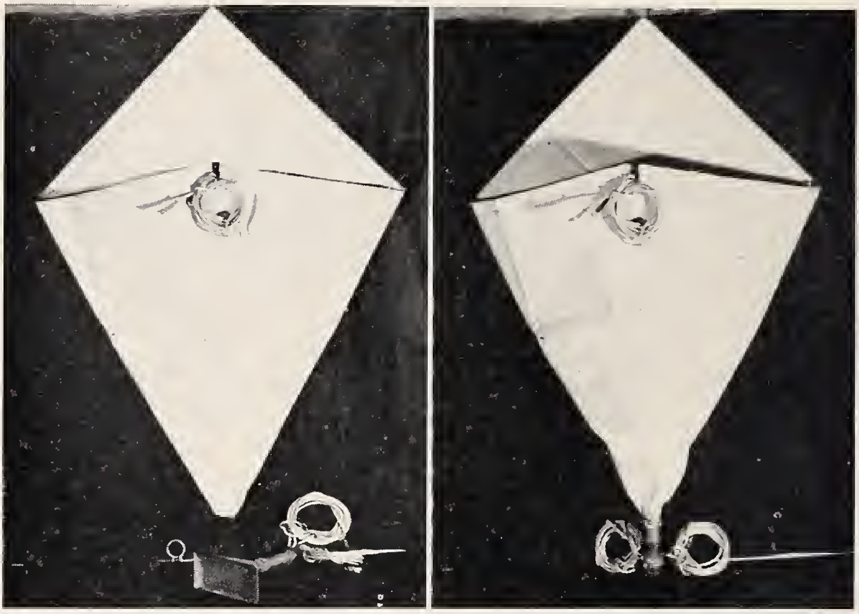
Forester, Siskiyou National Forest, U. S. Forest Service

In the summer of 1944 Ranger L. J. Cooper of the Siskiyou National Forest needed a funnel intake for a gravity water supply, something that could be installed quickly in irregular stream beds. He discussed it with Al Love, fire warehouseman, who made an intake, illustrated in the accompanying photographs, from a piece of 10-ounce canvas 5 feet square, cut and folded as shown in the sketch.



Specifications for canvas gravity intake. Trim lines are brought together and lapped 1¼ inches. The lap may be sewed or cemented.

In use, the long point of the canvas is weighted down on the creek bottom with rocks and/or mud. By means of the rope attached to the top side of the canvas, the funnel is anchored in such a way as to hold that side up out of the water. A metal funnel fits inside the canvas one and is fastened to it with a 2-inch hose clamp.



Left, the metal funnel, with screen, pipe nipple, and ropes; right, the gravity intake assembled.

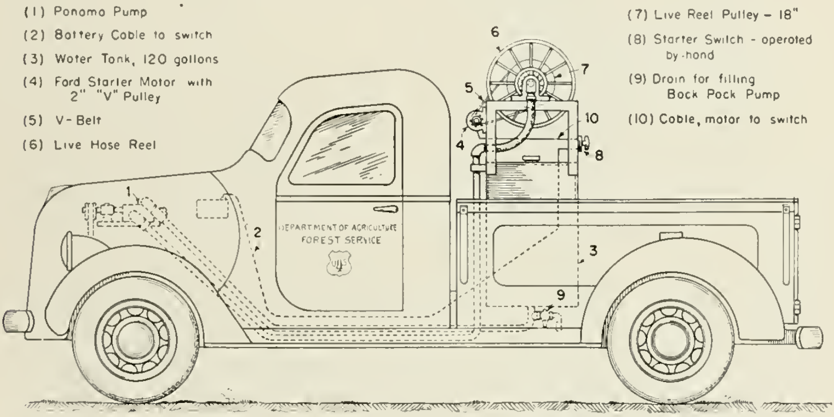
The opening to the metal funnel is 5 x 10 inches and is covered with ⅛-inch mesh screen. The outlet is brazed to a 1½-inch pipe nipple 8 inches long. A male hose coupling is welded to the outer end of the pipe nipple for the attachment of a standard 1½-inch hose. Two-inch rings are welded to opposite sides of the coupling for the attachment of ropes to anchor the intake and prevent it from being dragged by the pull of the hose. Tests indicate that this intake is better than any others tried on the Siskiyou National Forest for locations where the water supply is low and difficult to pick up.

LIVE HOSE REEL FOR PANAMA PUMP OUTFIT

M. S. Smothers

Forest Mechanic, Jefferson National Forest, U. S. Forest Service

In 1942 the Jefferson National Forest provided each ranger district with a Panama Pump mounted on a ½-ton pick-up equipped with a 120-gallon tank and 500 feet of ¾-inch hose mounted on a reel. The vehicles were not set aside for exclusive fire-control use, but were employed by the general district assistant in his regular year-round work. Thus, during the fire season he was always equipped with the pump, hose, and a tank full of water. Frequent use has also been made of them in mop-up work and in suppression of spot fires discovered along roadsides.


(1) Panama Pump
(2) Battery Cable to switch
(3) Water Tank, 120 gallons
(4) Ford Starter Motor with 2" "V" Pulley
(5) V-Belt
(6) Live Hose Reel
(7) Live Reel Pulley – 18"
(8) Starter Switch - operated by hand
(9) Drain for filling Back Pack Pump
(10) Cable, motor to switch
1
2
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10
DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Hose reel for Panama Pump outfit.

It was soon found that occasionally the unit had to be operated by a man working alone. Considerable difficulty was encountered by him in reeling up the hose without help. To solve this problem, a cheap but effective way was found to make the reel self-propelling. A second-hand Ford starter motor with a 2-inch V-pulley was installed on the hose reel frame; a V-belt connected the motor to an 18-inch V-pulley fastened to the reel; a starter switch mounted on the frame and connected with the motor by a piece of battery cable operated the motor; and current was supplied by the car battery through a battery cable. The drawing illustrates the method of installation.

The cost of materials was approximately as follows:

Starter motor (second hand)	$2.00
Starter switch	1.65
2-inch pulley	.50
18-inch pulley	3.00
V-belt	1.25
Battery cable (8 feet)	2.25
Total	$10.65

The mechanic's time involved about 4 man-hours and the helping mechanic an additional 4 man-hours.

POWER CHAIN SAW CARRIAGE

John W. Parker

Forester (Fire Control), Boise National Forest, U. S. Forest Service

Private industry and the fire-protection organizations have used the gasoline-powered chain saws very successfully in many types of work. However, to make the use of this expensive saw worth while, production must be increased several times over and above what can be done with an ordinary crosscut saw. One drawback in the use of the power-chain saws is that they are heavy and hard to transport. To overcome the difficulty of transportation, the Boise Forest personnel has developed a light carriage which can be attached to and detached from the saw easily and which is capable of moving the saw over very rough terrain. One-half-inch airplane tubing is used for most of the frame, which makes it both sturdy and light. The total weight of the carriage is 13 pounds. The carriage was built for the Disston power chain saw, but can be adapted easily to any other similar make.

The carriage can be attached to the saw or detached from it in 15 seconds or less because of simple construction. There are no nuts or bolts to be removed and nothing to be lost or misplaced. The rear part of the saw is attached to the carriage by two bolts that fit into two holes in the frame of the saw. These bolts are tapered so that they slip through the holes easily and are bent back so that the saw cannot become detached while the front catch is in place. The front part of the saw is held in place by a hold-down clamp that fits into a ½-inch hole drilled in the abutment plate. The carriage is run on an ordinary 26-inch bicycle wheel.

Attaching the saw to or detaching it from the carriage can be done most quickly by one man as outlined in the following steps:

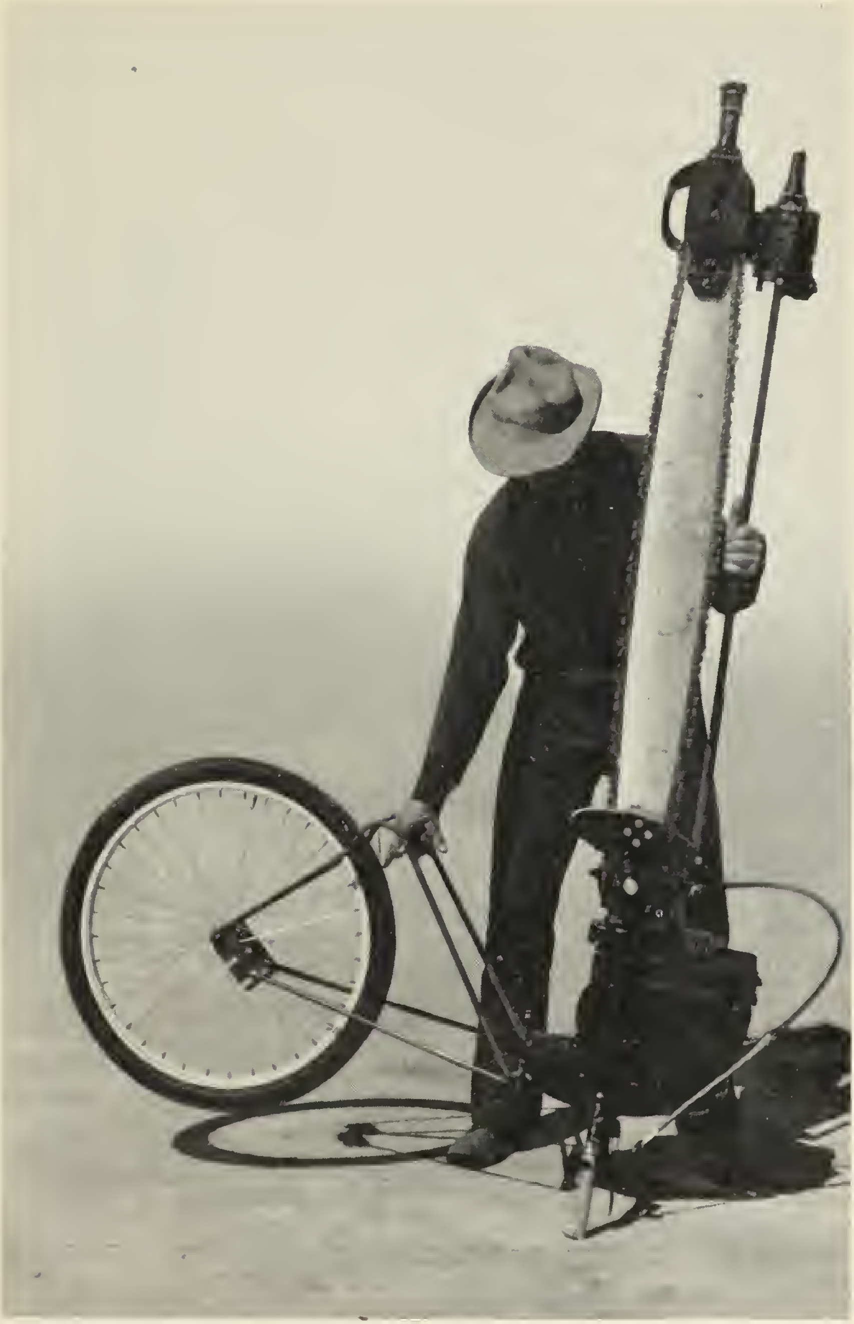
1. The power saw is placed on the ground.

2. The operator, using his right hand, takes hold of the front part of the carriage just to the right of the hold-down clamp.

3. With his left hand, he takes hold of the saw at some convenient point approximately in the center of the guide rail, and tilts the saw back on its handles till it is in a nearly vertical position.

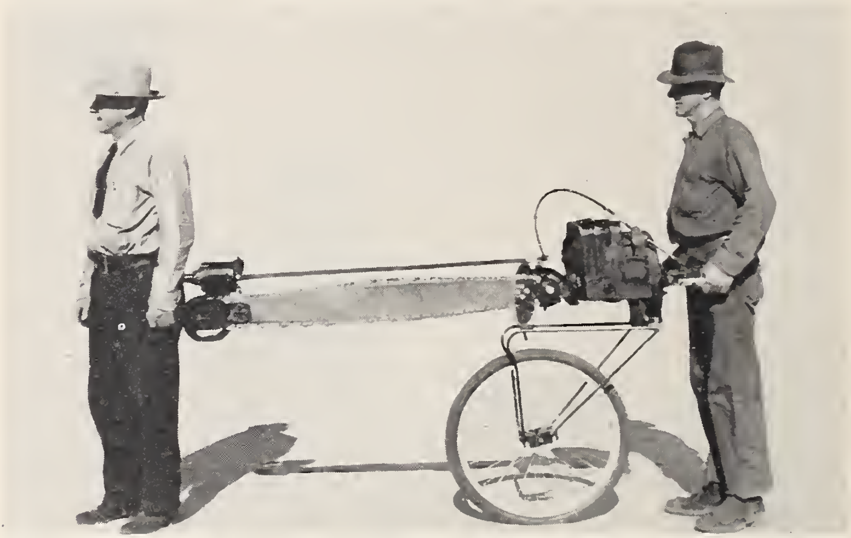
4. While holding the saw in a vertical position, the two bolts in the rear part of the carriage frame are put through the rear holes in the motor frame.

5. The saw is now tilted forward until its weight is resting partly on its handles and partly on the wheel. The saw will remain in this position with only slight steadying by the operator.



Mounting Disston power chain saw on carriage. One man can mount saw on carriage or dismount it in 15 seconds.

6. The hold-down clamp can now be engaged with the abutment plate with one hand.
7. The operator now grabs the handles of the saw and raises them to a convenient height, and the saw can be pushed wherever it is to be used.
8. To detach the saw from the carriage the process is reversed.



Disston power saw mounted on carriage. Unit can be moved by one or two men.

The saw can be moved by one or two men depending upon the terrain to be traversed. One man holds the rear handles and the other holds the tail stock handle.

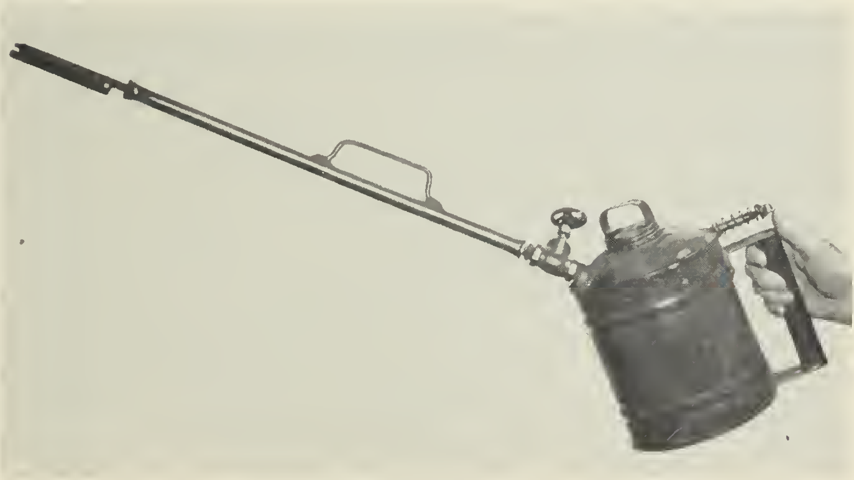
The power saw carriage can be constructed in nearly any shop by a competent mechanic. The cost of the unit is approximately $32 where one or two units are made.

THE FLORIDA DRIP TORCH

John W. Squires

Forest Supervisor, Florida National Forests, U. S. Forest Service

One of the most worth while developments that has come from the prescribed burning program in Florida has been a fast backfiring torch. Various flame throwers, propane torches, railroad fusees, and rakes had been tested previously. All of them had some weakness; they were either too burdensome to carry, too slow to do the job, or they didn't last long enough. Three years ago most of the backfiring was being done with an asphalt rake. When the Chief approved the large scale prescribed-burning program, it was apparent that the speed of firing would have to be increased in order to burn the necessary acreage on the few days during the winter months suitable for such burning. To burn 1,500 to 2,000 acres per day, it would be necessary to string from 40 to 50 miles of line.


The Florida drip torch.

The idea of the drip torch doubtless originated with the pressure backfiring torch which was first used on the Mathis 2-disk fire-line plow. With this torch attached on the back of the plow, it was possible to plow a line and backfire at the same time. The torch consisted of a 10- or 15-gallon gasoline tank equipped to be put under pressure. The nozzle of the feed line was placed just above a wick which was ignited, and the gasoline was thrown by pressure across the burning wick and over the plowed line. Some of the plows on the Florida National Forests still use this pressure torch. Under good conditions and with a supporting crew, it has been possible to plow 3 or 4 miles of line an hour and backfire it at the same time.

Members of the Osceola Ranger District and the Southern Forest Experiment Station at Olustee built and tested several backfiring torches in the fall of 1943. The model in use at the present time was made of a gallon kerosene can with a spout about 24 inches long, usually constructed from the inner barrel of a back-pack pump or of copper tubing. The end of the spout was filled with a rope or cloth wick just tight enough to allow the fuel to drip slowly when the spout was lowered. The principal difficulty was getting the proper type of fuel. The first tests were run with kerosene, with 1 quart of burnt motor oil added, and gave fairly good results. However, gasoline was tested with the motor oil mixture, and surprisingly the torch did not blow up. Safety experts maintain that such use of gasoline is very dangerous, so, even though the drip torch had been used for a month without an accident, it was decided that it must be tested. Two models were prepared and sent to the United States Bureau of Standards, where they were ignited and tested 50 times without accident. The Bureau, however, recommended the addition of a check valve air vent on the can and a loop in the spout as further safety precautions. One manufacturer has built a torch with similar specifications, but to date has been unable to produce more than a sample model. So far over 100 of the gallon-type drip torches have been built and used without an accident or an explosion, and 180,000 acres, which represents about 3,000 miles of back, flank, and head fire, have been prescribe-burned.

Naturally the Florida organization has learned a great deal about fire behavior and techniques for setting back, head, and flank fires. In the Florida forests most of the class C and larger fires are stopped with backfires. With the drip torch, backfiring can be done more efficiently and much faster. The speed of firing depends on the fuel being ignited.

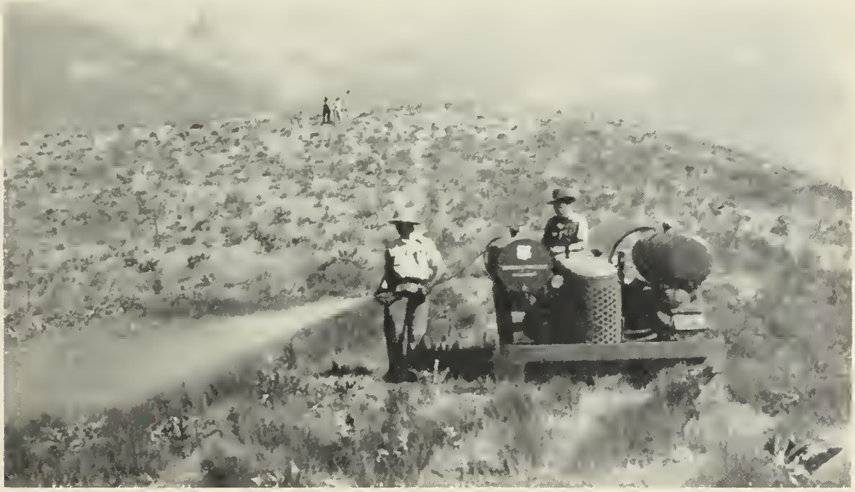
A man can string fire on the run at a rate of 5 to 7 miles an hour. The rate of firing on prescribe-burning averages from 2 to 3 miles per hour. By laying several parallel lines of fire in front of the head, the fire can be stopped with less chance of its jumping the backfire.

It has been found that with the drip torch, types that heretofore were almost impossible to ignite can be backfired. The scrub pine (pinus clausa) on the Ocala has always been difficult to backfire because there is very little fuel on the ground, but with the burning gasoline dripping on the light and scattered fuel it is possible to get a start in this type. All firemen in Florida now carry a drip torch in their pick-ups because they know that they are better able to handle a lot of grass fires by putting in a quick backfire.

FIGHTING FIRE WITH FOG

J. W. West, *Assistant Supervisor, and* Lowell J. Farmer, *Forester,*
Wasatch National Forest, U. S. Forest Service

A brand new grass and brush fire-fighting machine evolved through the combination of a guayule project weed-spraying tractor and Region 5's mechanical adaptation of it, had its first work-outs this summer (1945) on the Wasatch National Forest (R–4) with some promising results. The machine consists of a model H. G. Cletrac crawler tractor with the gage widened from 42 to 55 inches by offsetting the left track 13 inches. It carries a Bean model Royal 10 pump of 17 g. p. m. capacity against a 600-pound pressure; two 53-gallon water tanks; 100 feet of ¾-inch high-pressure hose with Bean model 785 fog gun; 10 feet of 1-inch suction hose.



Trying out the fog nozzle on the watershed lands above Salt Lake City, Utah. The nozzleman and tractor operator easily work as a team on terrain like this.

It is estimated that Region 4's initial expense of $1,897 for the fully-equipped machine ($500 labor for conversion, $76 for freight, $1,321 for the used tractor and pump) was saved by effective performance on one fire. Three or four thousand dollars more will be needed to correct mechanical limitations and provide suggested improvements.

Operating costs total about $4.20 per hour: Operation and repair, $1.00; depreciation, $0.50; operator, $1.10; nozzleman, $0.80; helper, $0.80.

Under favorable conditions, the fog knocked out grass and brush fire at the rate of one mile of line per hour. Were this rate to be cut in half for an over-all average it still would represent marked improvement and saving over hand fighting. The machine can lay down a creeping barrage of fog and control one-half mile of grass fire in 30 minutes with one tank (53 gallons) of water. And that (experienced fire fighters will tell you) is really snuffing out fire.

In its present stage of development, the unit can climb safely and perform on grass and light brush slopes of not more than 40 percent grade. Its water supply will provide fog for 40 minutes or a continuous stream of water for 17 minutes. Experience indicates that in either mop-up or suppression the greatest efficiency is obtained by using short bursts rather than steady streams of water or fog. This calls for a skilled and experienced nozzleman who knows whether stream, spray, or fog is needed, how much, and for how long. A fog knocks out running grass fires but a stream or spray is best for mop-up work in duff and litter.

The grass and brush watershed on slopes like this above Salt Lake City are easily negotiated by the unit.

The pump attachment operating by sprocket and chain drive from the power take-off will automatically maintain any pressure for which it is set. The high nozzle-operating pressure (most satisfactory at 600 pounds) makes it impossible for the operator to manipulate the flow, that is, the nozzle trigger must be either open fully or closed.

The ideal method of operation is for the outfit to make its way around the fire line snuffing out the fire as it goes. Three men (operator, nozzleman, and helper) all working together can perform most efficiently with the helper keeping the necessary length of hose reeled off, seeing that it does not catch, and helping the driver spot the best line of travel. Both nozzleman and helper get the best results on foot where they are free from the uneven motion of the tractor.

For highest efficiency careful supervision and pretraining are required. On one fire the fire boss directed the machine to attack at a place that was, in the judgment of the operator, not traversible. As a result the outfit became hopelessly stuck and remained useless for the remainder of the suppression work.

The fire fogger can operate safely up to a 40-percent grade on country like this

Performance tests conducted May 24 and 25, 1945, on the Los Padres National Forest and during July on the Wasatch National Forest showed that an improved machine should:

1. Be able to traverse slopes up to 50 percent through moderate brush.
2. Carry about 150 gallons of water or fuel in enlarged tanks.
3. Have increased gear ratios for more stability and speeds as low as 1 mile per hour forward and in reverse.
4. Have lengthened track assemblies with more of the load placed forward for better balance.
5. Have increased size of sprocket on power take-off to prevent overheating.
6. Have power-driven fuel pump to insure carburetor feed on steep slopes.
7. Have redesigned safety platform for nozzleman or riders.
8. Have rack for suction hose when not in use.

The test unit is considered, by those who have seen it in action, "a promising and effective fire fighter. With the added features shown by these tests to be needed, it can be made into a most efficient brush and grass fire-fighting machine.

THE FOGGER'S VITAL STATISTICS

Tractor:
- Model—HG42 Cletrac.
- Type—Track layer.
- Track width—10 inches.
- Ground contact—50 inches per track.
- Tread—55 inches (offset).
- Right half—21 inches.
- Left half—34 inches.
- Maximum pull—2,800 pounds.
- Weight—3,000 pounds.

Engine:
- Make—Hercules 3 x 4.
- Type—4-cylinder gasoline.
- Maximum horsepower—
    - 19.4 belt.
    - 14.0 drawbar.

Speeds:
- Forward—
    - First—2 miles per hour.
    - Second—3 miles per hour.
    - Third—5 miles per hour.
- Reverse—2.35 miles per hour.

Pump:
- Make—Bean.
- Model—Royal 10.
- Type—Triplex reciprocating.
- Discharge capacity—17 gallons per minute at 234 revolutions per minute.
- Working pressure—600 pounds per square inch.
- Weight—280 pounds.

Tanks:
- Type—Cylindrical with 2 baffle plates.
- Capacity—53 gallons.
- Number—2.
- Mounting—Directly above tracks.
- Dimensions—Diameter 20 inches, length 48 inches.

Accessories:
- One live hose reel with capacity for 100 feet of ¾-inch high-pressure hose.
- Ten feet of 1-inch suction hose complete with couplings and strainers.
- One model 785 Bean spray master fog gun with removable tips and a discharge capacity of from 6 to 15 gallons per minute.

Total weight:
- Tanks empty—4,700 pounds.
- Tanks filled—5,600 pounds.

NEW AX SHEATH

V. C. Hallin

District Ranger, Trinity National Forest, U. S. Forest Service

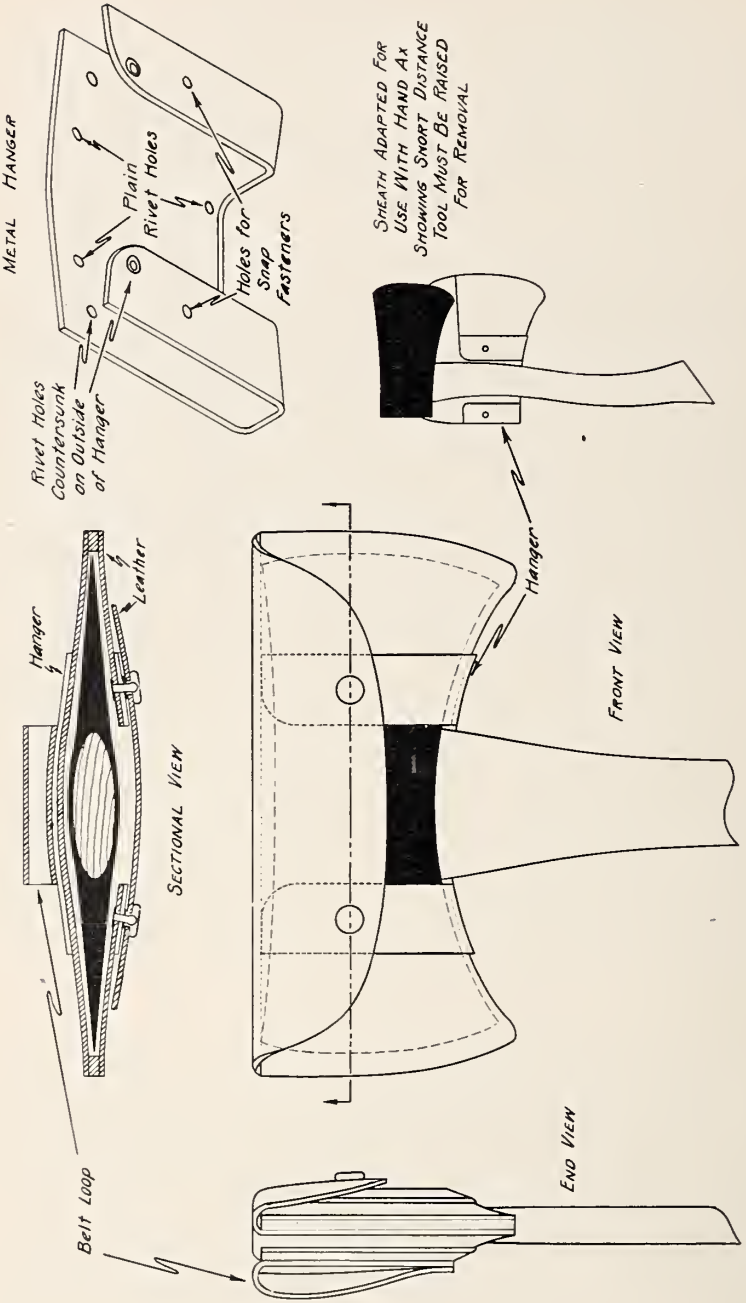
Inconvenience in sheathing and unsheathing has probably been the main obstacle to greater use of the conventional ax sheath. The same might be said about the standard carrying case for the light ax and hand ax. Since these are more readily carried at the belt than the regulation ax, the average woodsman will frequently continue the two-handed struggle every time he sheaths or unsheaths his hand ax, so that he may have his hands free for other duties while not engaged in chopping. In spite of its awkwardness, however, even the standard sheath has many advantages. It protects the tool from the elements, guards it against corrosion and abrasion, provides a convenient means of transportation, and is a safeguard against most accidents which might occur if cutting edges were exposed.

The writer, believing the woodsman should have better access to the tools which are his mainstay on the trail or fire line, in cruising timber, or on almost any other type of woods work, conceived the idea of a new type of sheath. This provided for encasing the central portion of a double-bitted sheath in a metal hanger, and cutting an opening through the outer side walls of both hanger and sheath to permit side entry of the ax handle. Two snap fasteners to lock the flap, and attachment of the belt loop to the back, complete the job. With the ax in sheath suspended from the belt, it is easy to grasp the flap and disengage both fasteners, grip the ax handle 6 to 8 inches below the bottom of the sheath, raise the ax until the head clears the hanger, and remove the tool with a sideward movement—all in a single-handed operation. Return of the ax to the case is almost as easy.

Advantages of Sheath

With any sheathed ax carried at the belt, there is always the possibility of taking a fall, catching the end of the handle in the ground or on some object, and then through failure of the flap fastening device, or because the latter is left unlocked, forcing the ax head from the sheath into a dangerous position. The Hallin holder will not entirely eliminate these dangers, but it does provide a greater opportunity for the ax to fall clear of the sheath.

The hanger type of carrier is not limited to the double-bitted ax. It may be adapted to the pole ax, hand ax, hatchet, marking ax, hammer, or almost any tool that can be suspended between two nails driven into a wall. The use of the hanger sheath for the marking hammer would do much to simplify the scaler's job. Similarly, the hanger sheath could be utilized to facilitate the work of the fire fighter, lineman, carpenter, timber cruiser, and many others.


METAL HANGER
Plain Rivet Holes
Holes for Snap Fasteners
Rivet Holes Countersunk on Outside of Hanger
SHEATH ADAPTED FOR USE WITH HAND AX SHOWING SHORT DISTANCE TOOL MUST BE RAISED FOR REMOVAL
Hanger
Leather
SECTIONAL VIEW
Hanger
FRONT VIEW
Belt Loop
END VIEW

DOUBLE-BITTED AX AND SHEATH

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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FIRE CONTROL NOTES

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A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 7 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire-fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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USING BLOODHOUNDS TO PREVENT FOREST FIRES

D. W. Beck

Forester, Eastern Region, U. S. Forest Service

Many fire-control men have felt the urge to use bloodhounds to find persons guilty of causing forest fires. Relatively few, however, have actually employed them and determined their value in fire control. Some men hesitate for fear of public opinion or the possibility that grudge fires may follow use of dogs. Others point out that evidence obtained in this way is not admissible in court. Still more just don't like dogs or understand them.

Dogs on the Job

In certain areas bloodhounds have been used enough to prove their worth in fire prevention. Their chief value is in reducing the number of incendiary fires. Dogs may trail and find the guilty persons or scare them so thoroughly that they will start no more fires. In many areas the very fact that fire-control men have a bloodhound available reduces man-caused fires. In the Eastern National Forest Region dogs have been used with marked success on the Monongahela National Forest in West Virginia and on the Cumberland National Forest in Kentucky. The State of West Virginia has also used hounds successfully in reducing fires in the hot-spot southern section of the State. Good results have also followed the use of dogs on the Ouachita and other national forests in the Southern Forest Region. In every case public comment on the successful conclusion of a case has been, "It served him right," or "Now they really mean business."

A few successful fire-law-enforcement cases where the dog finds the suspect do much to increase the prevention value of the hounds. On the other hand, some hard-luck cases (and anyone who uses hounds will have them) will lower respect for the dog. A good dog has a 50–50 chance of pointing out a suspect. Hot, dry weather conditions and old trails work against him. He needs a sure starting point, and it should not be held against him if more than one man passed that point.

Shall We Use Dogs?

Several considerations, including the local point of view, must enter into the decision of the fire-control man to use bloodhounds. Do the persons who start the fires travel by foot? Are they local people or "outsiders"? Can the proper man be found to train, handle, and care for the dog? How can the most favorable public reaction to use of the hound be obtained? What weight will be given the dog's evidence in local courts?

A bloodhound is not a substitute for a well-trained investigator. Very few court cases have been won on the hound's evidence alone. The dog will do his part in most cases by following the trail to the man or to the point where he leaves no trail. His trailing will indicate who the suspect is and give reasonable assurance that the man was at the point where the hound picked up the trail. Once the suspect is determined, it takes hard work and properly timed action to get all the facts for a court case. With the information supplied by the dog's trailing, the investigator can usually do the rest of the job.

English bloodhound Texas Black Sam with Fire Control Assistant Ledford Perry at Buck Knob Lookout, Laurel District, Cumberland National Forest, Ky.

Bloodhounds are not infallible; they differ even as people do. Some have a good nose, some don't; some work slowly, some fast; some will work with anyone, some only with a trainer who can handle them. All work better with a person to whom they are accustomed. Give the dogs every possible "break" on their first few cases and so help to build local respect for their ability.

If the decision is made to use the dogs, the job must be a thorough one. Very few dogs are suitable for fire law enforcement. Training is even more important than pedigree, but dogs purchased for a fire job should have both. Experience in using bloodhounds on the national forests in Arkansas, West Virginia, Virginia, and Kentucky shows that the best results are obtained by purchasing dogs 3 to 5 years old with at least 2 years' intensive training in trailing. Good dogs usually cost from $100 to $200.

Care of Dogs

Dogs require good care, good food, and a comfortable kennel with a good, well-fenced yard. They should have fresh water at all times. Straw should be changed at least every 2 weeks and the kennel kept clean. They should be washed with flea soap regularly and should be inoculated for rabies and examined for heartworms annually. Dogs should be wormed when necessary. Keep the public away from the kennel. Accustom the dogs to working with a local man. A man who does not like dogs will not do a good job. A trial run once or twice a week during periods when the dogs are not being used will keep them in good condition.

Trailing

Bloodhounds are trained to follow men. They will not follow a horse and cannot trail a man if he gets into a car. A great many cases end for the hound where a car has been parked. From this point on, the investigator must use other methods.

Dogs differ in their trailing methods. Some get the scent from bushes or even through wind currents. Such dogs sometimes short cut the exact trail. Some trail with nose to the ground, tail high. Most of them are difficult to hold, particularly on a downhill trail or through bushy or rough areas. Some dogs bay on the track; some trail silently, depending on their training. A silent trailer is preferable for obvious reasons.

When dogs are taken from the kennel for a chase, they should have both harness and collar in place. The leash should be attached to the collar until the dog is ready to trail. Hold the leash close to the dog's neck to prevent trailing until the desired starting point is reached. When trailing, change the leash from collar to harness and point or show the dog the starting point. Then take it easy and he will soon strike out on the trail. Some dogs get car sick. It is best not to feed them just before they are expected to work.

Local Requests for Use of Dogs

Frequently there are requests for the dog's services in work other than fire cases, once he has shown that he can work out a trail. Forest Service dogs have found persons lost in the woods. Calls are received from local police officers for the use of the dogs in cases involving everything from murder to theft. To assist in these cases on request takes the dog and handler from their regular duties. A local policy must be developed for handling these requests.

Summary

If the fire control administrator decides to use bloodhounds to clean up hot-spot areas, he should buy the best trained dogs obtainable. The best possible man should be hired to handle them. It is important that the dogs be given every advantage on their first three or four cases. They should have a good starting point. If the fire control man takes the attitude that every possible means must be used to stop fires from starting, public reaction will be favorable. Additional work will be needed to close each case satisfactorily after the dogs do their part. It must be recognized that dogs will not do the whole job and that other prevention methods are still required.

In most cases the use of dogs markedly reduces man-caused fires in areas where they have been numerous.

THE FOREST SERVICE ADOPTS FM RADIO

HAROLD K. LAWSON

Radio Engineer, Radio Laboratory, U. S. Forest Service

If you are planning to install radio communication or to expand or revise your present facilities, you will be interested in the following discussion of the FM radio equipment which the U. S. Forest Service has adopted.

The form and characteristics of the new equipment are not described in detail. It is of interest to know, however, that the portable and mobile equipment is being designed to incorporate two fixed transmitting frequencies and only one fixed receiving frequency.

Many radio communication failures are due to equipment manipulation—especially the tuning of radio receivers. A fixed tuned receiver completely eliminates the possibility of maladjusted tuning or stand-by on the wrong frequency, both of which are prime causes for radio communication failures. It also eliminates all tuning knobs and controls and brings radio nearer to the simplicity of the telephone.

Methods of obtaining maximum radio network performance and traffic handling capability with a minimum number of frequencies, by use of the equipment now under development, will be discussed in a future issue of Fire Control Notes.

Forest Service communication officers and others have asked why the Forest Service radio equipment program did not follow the current trend in the use of frequency modulation (FM). In the first place, amplitude-modulated (AM) sets cannot communicate directly with FM sets, and our present investment in AM equipment must be considered before this equipment is isolated from our communication systems. Also, until very recently it has not been possible to produce truly portable FM radiophones because of their bulk and inherent complexities. Forest Service radio use is so intimately tied to portable communication service that, regardless of any advantages, FM could not be considered until portable equipment development was an assured fact. New techniques, parts, and materials now make it possible to produce portable FM radiophones.

Practically all commercial development of emergency service radio equipment is now centered in the FM field. Many law enforcement and similar agencies which formerly used AM have changed over to FM. Because of these facts and the technical advantages of the new system, we have swung our VHF radio development program over to FM. This decision is of major importance in our communication planning and execution.

A brief resume of facts relating to the subject of AM–FM follows:

1. Under identical conditions of frequency and power, FM radio waves travel in an identical manner and both will have the same effective strength at a given distance from the transmitter. In other words, under identical conditions, one is transmitted as effectively as the other.

2. Under conditions of absolutely noise-free radio station locations the effective communication range of the two systems will be nearly identical.

3. Under conditions of strong natural or man-made electrical interference FM signals are usable when AM signals may be completely drowned out by noise.

4. Precipitation or rain static that can completely disable an AM radio system is not heard on FM equipment.

5. The interstation noise-silencing system (squelch) on an AM radio receiver is subject to false operation by electrical noise and static bursts and allows blasts of noise to issue from the loud-speaker when the receiver is on stand-by. FM squelch is almost entirely free of such false operation. This factor allows noise-free stand-by in mobile service and in offices and similar installations where the usual loud-speaker background noise is objectionable.

6. Certain technical characteristics of an FM radio receiver make it possible to produce simpler and more reliable automatic radio relays or repeaters with this system than are possible with AM.

7. Manipulation of FM and AM equipment is practically identical, and no new operating problems arise from change of system.

8. Radio operating frequency distribution as between districts, forests, and regions will, at least for the present, remain as for AM. Further experience with FM may point to the possibility of closer geographic frequency repetition than is possible with AM, but this must await confirmation through use.

9. Basic equipment types will not be altered in the change-over to FM. We will continue with portable, semiportable, mobile, and repeater types of equipment. The user will not find any unusual differences in the two systems, and the net gain will be apparent only as a sum of the individual improved characteristics, which in turn will mean an over-all improvement in quality and reliability of service.

10. The change-over to FM affects only our VHF equipment. Our MF and HF frequency bands, which employ equipment types such as SPF and M, will remain the same.

We are still forced to carry out our own development and design of portable units, but we hope that much of our mobile and fixed station equipment can be obtained from commercial sources at less cost than that for custom-built items. Cost of the new equipment can only be estimated roughly, but should not vary greatly from that of comparable AM types.

The radio laboratory cannot possibly complete all items of equipment in time for contracted production in 1946. It will accordingly concentrate on the portable design in an attempt to be ready for quantity production by January 1, 1947. In the meantime, an attempt has been made to interest commercial concerns in some modifications of their standard mobile equipment to meet our needs. Other items, such as lookout radiophones and repeaters, will follow.

Transition will be based on removal of AM from one area to supply the needs of other areas and replacement of the shifted equipment with FM. This will prevent immediate obsolescence of usable AM equipment by concentrating it in selected areas that have an appreciable amount of AM equipment and need additional units. The logical starting point for introducing FM should be an area in which adjacent district, forest, or regional intercommunication is a minor factor and which has a reasonably well self-contained radio net.

Such a program will allow correction of certain undesirable radio equipment distribution problems which may now exist. At the same time, full opportunity should be taken to carefully plan equipment choice and distribution for the new networks. There are bound to be conflicts in this process before the entire AM system is liquidated by age and obsolescence, but there is no reason to discard usable AM sets immediately. A small amount of new AM equipment may be necessary in some instances, but every effort will be made to keep such purchases at a minimum.

Airborne Cooperation in Region 2.—Forest fire cooperation has reached a new high on the Harney National Forest, where Ranger Everett A. Shipek reports the following:

"Harry D. Putnam, Forest Fire Warden at Burdock, S. D., uses his private plane, a Cub J–3, to spot and suppress forest fires. While in Dewey, S. D., June 29, Putnam, a veteran of the American Air Force, received word of a fire on the Elk Mountain District of the Harney National Forest. Taking a local man with him and picking up fire tools at Dewey, he scouted the fire with his plane. Landing in a field within one-half mile of the fire, the two men controlled the 0.2 acre lightning fire within a few minutes. Warden Putnam's plane is an important factor on this portion of the forest where the high hazard makes minutes count in fire control."

THE PROFILING SLIDE RULE AND ITS USE

Aubrey L. Haines

Ranger, Yellowstone National Park

The potential value of a slide rule in checking the intersection of a line of sight with distant topography in making visible area maps was first brought out by Rudolph Stahelin in 1932.[1] Techniques were developed and perfected to put the slide rule to work in field sketching of visible areas by the California fire research group in 1932–35 and have been fully described in published material.[2]

District Ranger Albert D. Rose, of Mount Rainier National Park, helped to develop the original rule and made many tests with it while he was fire dispatcher. He found that a fire can be located in from one-third to one-half the time required by graphic profiling and that errors due to paper distortion and incorrect plotting of the vertical angle are eliminated. The following statement from Mount Rainier National Park is based on 6 years of thorough trial: "The accurate and rapid results obtained in plotting fire locations by use of the profiling sliding rule * * * has convinced us at Mount Rainier that it is the most reliable instrument available for such purposes."

In recent years the technique has been neglected. The author brings the method to attention again and shows how it may be adapted to regular lookout use by means of a specially constructed slide rule. The technique is necessarily limited to areas for which reasonably accurate topographic maps are available.

Locating "One-Shot" Fires

The profiling slide rule described in this article provides a speedy and accurate solution for a difficult fire problem. Rugged topography or poor visibility may make it impossible to observe a forest fire from more than one lookout station. The lookout observer usually has little to guide him in judging how far away the fire is. Phototransit pictures are useful, but often inconclusive. If a good topographic map is available, a profile of the terrain can be constructed to determine where the line of sight intersects the ground. This can be done in two ways; graphically, with varying accuracy and loss of valuable dispatching time, or mathematically. The profiling sliding rule, developed at Mount Rainier National Park during the 1938 fire season, makes the mathematical solution practical by simplifying the necessary calculations. It has proved satisfactory for locating "one-shot" fires, checking doubtful triangulations, training new lookout men, and making seen-area studies.

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[1] Stahelin, R. Visibility maps constructed with the slide rule. Jour. Forestry 30: 983–987, illus. 1932.

[2] Show, S. B., Kotok, E. I., Gowen, G. M., Curry, J. R., and Brown, A. A. Planning, constructing, and operating forest-fire lookout systems in California. U. S. Dept. Agr. Cir. 449, 56 pp., illus. 1937.

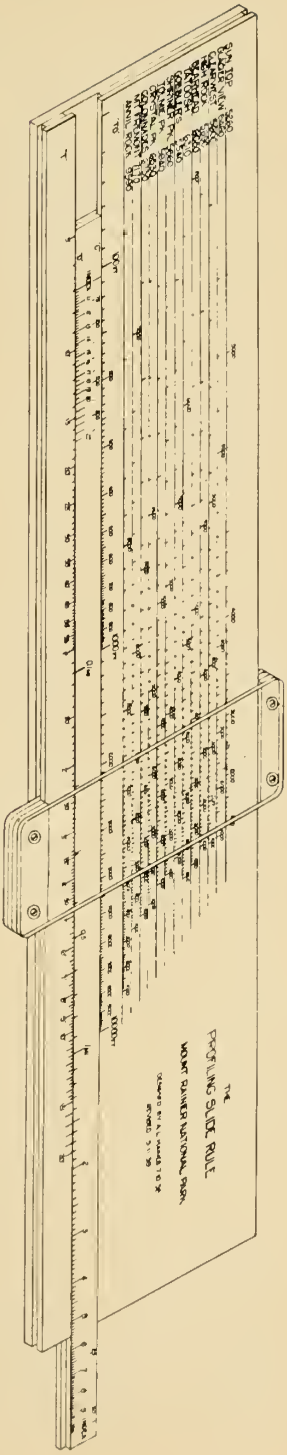
Description of the Profiling Slide Rule

This specialized instrument is designed for use by men with no knowledge of the theory or operation of slide rules. It is 32 inches long by 6 inches wide. The large size is not a disadvantage in a purely office instrument. The body is built up of three layers of $\frac{3}{16}$-inch "Masonite" board worked to size with a saw and rasp and joined with waterproof glue and a few brads. The slide is 1 inch wide and is built up of two layers. Wood is not satisfactory for the construction of the slide rule, since shrinkage or warping will cause the slide to bind.

The three working scales, the tangent *T* on the lower limb, the distance *D* on the slide, and the tangent-offset *TO* on the upper limb are logarithmic. Each is composed of three cycles, with the first cycle beginning at the normal position of the left index. The length of the cycles allows graduation of the scales directly from logarithmic tables of numbers and angular functions.

The scales are graduated as follows: Tangent *T* graduation marks are placed by reference to a table of logarithmic tangents of angles. The mantissa of the value is multiplied by 10 and scaled off as inches from the left end of the cycle in which the graduation mark belongs. For example: The mantissa of the log-tangent of 5 minutes is 0.1627, which, multiplied by 10, places the 5 minutes graduation at a point 1.627 inches from the left end of the first cycle. Graduation marks are placed at 1-minute intervals from 5 minutes to 1°; at 5-minute intervals from 1° to 5°; at 10-minute intervals from 10° to 15°; and at 1° intervals on up to 20°.

Distance *D* graduation marks are placed by reference to a table of common logarithms of numbers. The procedure followed is the same as in graduating the tangent scale. The first cycle is graduated at 0.2-mile intervals from 10 to 15 miles; at half-mile intervals from 15 to 20 miles; and at 1-mile intervals on up to 25 miles. The second cycle is gradu-



ISOMETRIC VIEW

ated at 0.1-mile intervals from 0.1 to 1 mile, and the third cycle is graduated at the same interval from 1 to 10 miles. The left and right indices occupy the positions of the 10-mile graduations.

Tangent-offset *TO* graduation marks are placed by reference to the same table used for the distance scale. However, the tangent-offset scale is shifted to the right until the point 52.8 is opposite the normal position of the left index. Thus it becomes a scale of foot equivalents of miles. Graduation marks are placed at 10-foot intervals from 40 to 1,000 feet and at 100-foot intervals from 1,000 to 10,000 feet.

In addition to the distance scale on the slide, there is a scale of corrections for curvature and refraction C. The correction scale graduations are placed from the formula, $D=\sqrt{\frac{C}{0.574}}$, where D is the distance scale graduation opposite which the correction graduation C is placed. For example: To find the point on the distance scale at which the 25-foot correction mark is placed, $D=\sqrt{\frac{25}{0.574}}=6.6$ miles. Graduation marks are placed at 25-foot intervals from 25 to 200 feet and at 50-foot intervals from 200 to 300 feet.

A series of profile elevation scales on the upper limb are in effect a reference table in graphic form. The profile elevation scales are graduated by subtracting the tangent-offset scale values from the elevations of given lookout stations. For example: The 9,000-foot graduation for the Anvil Rock Lookout is found by subtracting 9,000 from 9,590, which places the graduation mark opposite 590 on the tangent-offset scale. Graduation marks are placed at 100-foot intervals on all profile elevation scales.

The slide rule is completed by a large cursor of heavy transparent plastic with "Masonite" runners. A vertical hairline inscribed on the cursor aids in reading the profile elevation scales.

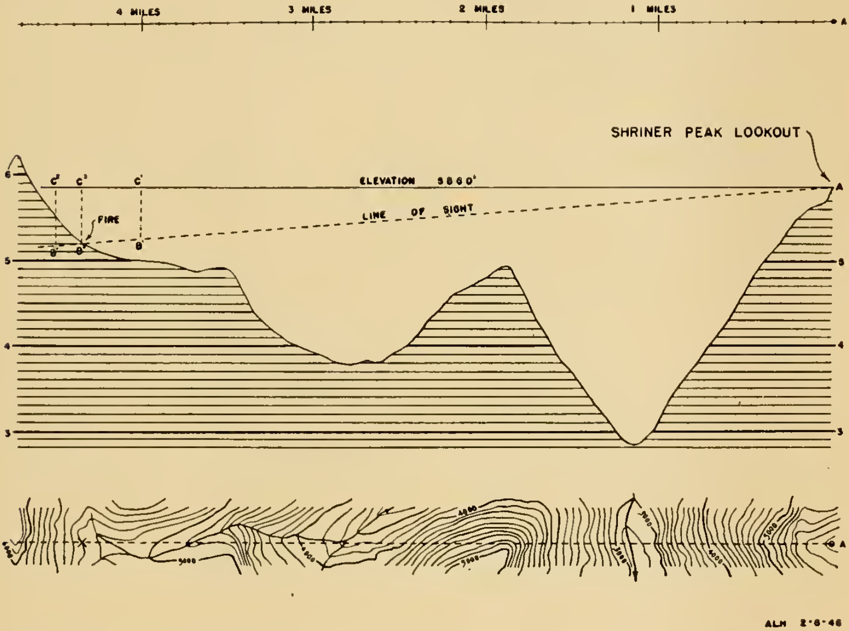
Operation of the Rule

The profiling slide rule determines the location of a fire by a method of approximation based on a trigonometric relationship of simple right triangles, $a=\tan A\times b$. Briefly, the tangent value of the vertical angle is multiplied by the estimated horizontal distance to obtain the tangent-offset or difference in elevation. That value subtracted from, or added to, the height of the lookout station gives the elevation of the point observed with reference to sea level. The elevation thus found is compared with the map elevation at the scaled distance and, if they do not agree, it is apparent at once that the estimated distance is wrong. The estimated distance is then adjusted in a direction which will tend to bring the values into agreement and a new solution is obtained. The second or third approximation will usually locate the point as closely as the topographic map will allow.

A typical problem is worked out below. It is assumed that the fire can be seen from a single lookout station, Shriner Peak. The lookout has given the dispatcher an azimuth, a vertical angle, and an estimated distance. The problem is to determine the position of the fire with the aid of a topographic map.

A tentative elevation is obtained on the profiling slide rule by setting the right-hand index of the slide opposite the vertical angle of −1°38′ and moving the cursor until the hairline lies over the estimated distance of 4 miles. The profile elevation of 5,250 feet is then read from the intersection of the hairline and the Shriner Peak scale. A difference of 250 feet exists between the profile elevation and the map elevation at the same distance, indicating that the estimated distance is not correct.

The profile elevation is higher than the map elevation, so it is necessary to extend the estimated distance to bring the line of sight to ground. A second approximation is therefore made by moving the cursor to 4.5 miles. The new profile elevation of 5,180 feet is lower than the map elevation at the same distance; the estimated distance used is too long. A third aproximation using 4.35 miles gives a profile elevation of 5,200 feet which checks with the map elevation at that distance. The fire is located as closely as possible with the available topographic map.



The method of approximation used on the profiling slide rule to locate a fire. Vertical angle, −1°38′. First trial: AC¹, 4 miles; C¹B¹, 610 feet; elevation of B¹, 5,250 feet. Second trial: AC², 4.5 miles; C²B², 680 feet; elevation of B², 5,180 feet. Third trial: AC³, 4.35 miles; C³B³, 660 feet, elevation of B³, 5,200 feet.

In this case the distance used is not great enough to make the correction for refraction and curvature of the earth necessary. If a distance greater than 5 miles is employed, the correction should be made by mentally adding to the profile elevation the value of the *C* scale graduation lying nearest the hairline of the cursor. In setting the slide for a solution, the right-hand index is ordinarily used for distances of less than 10 miles and the left-hand index for distances over 10 miles.

A check-back should be made on intervening ridges that might cut the line of sight. Otherwise an erroneous location of the fire might be made. In any case where the clearance is slight, a check should be made with the lookout and the vertical angle carefully verified. Check-backs are made rapidly by sliding the cursor to the scaled distance of the ridge and reading the profile elevation against the map elevation. The profiling slide rule will not locate a fire, however, if the base is not directly visible. Such a fire cannot be located by any method of profiling.

Other Uses

In addition to its use for locating fires observed from only one lookout station, the profiling slide rule can be used to check doubtful triangulations. It frequently happens that one fire lookout can see the base of a fire, while another one can see only the smoke rising from behind a ridge or other obstruction. The triangulation may be in error if the smoke drifts for a distance before it becomes visible. This can be detected by employing the profiling slide rule to check the data supplied by the station with direct observation.

The profiling slide rule can also be used for making seen-area maps, either in the field or in the office. In the field the slide rule is used in the manner already described to interpret data obtained with a transit, plane-table alidade, or clinometer. A sheet of grained acetate film base taped over the profile elevation scales can be graduated quickly for both plus and minus angles from the point occupied. Erasures are readily made on such a surface. In the office the operation is changed slightly. The blind area behind a ridge is found by first setting the cursor against the map elevation (less the correction from the *C* scale), and then moving the slide until the scaled distance of the ridge lies under the hairline of the cursor. The vertical angle of the line of sight is thus established, and the solution proceeds by the method of approximation already described until the outer edge of the blind area is found. An experienced operator can complete an accurate seen-area study to a 15-mile radius in an average of 8 hours of working time.

HOW MUCH TIME DOES IT TAKE TO CATCH A FIREBUG?

HENRY SIPE

Assistant Supervisor, Cumberland National Forest, U. S. Forest Service

The question frequently arises: How much time is required to investigate the origin of a fire to determine beyond a reasonable doubt who caused it? It comes up when analyzing the work load of any unit involving fire prevention. It is important when making actual work plans for personnel who are to do the fire prevention jobs.

Fire control men agree that the causes of fires must be known if adequate plans are to be made to prevent future fires. It must be known not only that a "smoker" caused the fire, but *who* was that smoker. Reprimand, payment of damages, or legal action must follow if full prevention value is to be obtained. The amount of time required to establish accountability for fires varies greatly. To secure data based on actual fires, the writer summarized the time spent by rangers and guards in law enforcement on the Cumberland National Forest in Kentucky during 1945. This time-study was carried on while making current diary summaries and checks on all kinds of work performed during the year on four ranger districts. The basic data in man-hours are given in Table 1.

TABLE 1.—*Man-hours spent in law enforcement on 51 fires on the Cumberland National Forest in 1945*

District	Number of fires	Office		Field job		Field travel		Total	
		Year's total	Average per fire	Year's total	Average per fire	Year's total	Average per fire	Year's total	Average per fire
		Man-hours	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Man-hours*
A	12	23	1.9	149	12.4	62	5.2	234	19.5
B	7	5	.7	44	6.3	36	5.1	85	12.1
C	6	4	.7	108	18.0	39	6.5	151	25.2
D	26	48	1.8	13	5.2	46	1.8	228	8.8
Total or average	51	80	1.6	435	8.5	183	3.6	698	13.7

Table 1 includes 32 hours spent in closing out 6 fire cases which originated prior to 1945. These 6 are not included in the number 51 because there is always a carry-over of cases from one year to the next on the Cumberland. In other words, some of 1945's 51 fires will not be investigated and acted on until 1946, or even later.

The question now arises: How effective was the 1945 work? What was accomplished with the expenditure of the time shown in table 1?

Table 2 shows that in 26 out of 51 cases sufficient clues were uncovered either to open legal action for criminal cases, or to request and receive payment of damages. Civil damages were not collected in the 7 criminal cases, nor was criminal action taken in the 19 "damages collected" cases. Five of the 7 criminal cases were won and 2 lost. It will be noted that there is not a clear relation between the amount of time spent by districts as compared with the number of cases initiated (criminal plus damages). Various factors affect this lack of relationship, such as causes, groupings, ability and thoroughness of individual investigators, press of other work, and plain luck. For example, table 3 shows that smokers were responsible for most of District A's fires—very tough cases to solve. Nearly one-fourth of District D's fires were caused by railroads, which on this forest require little time to investigate; damages were collected on all of them. All personnel were operating under the same policies and instructions, but the writer could discern these variable factors in action.

TABLE 2.—*Results of law enforcement work on 51 fires on the Cumberland National Forest in 1945*

District	Actionable fires	Criminal cases initiated	Damages collected out of court
	Number	*Number*	*Number*
A	12	1	2
B	7	3	1
C	6	1	4
D	26	2	12
Total	51	7	19

Table 3 shows the causes listed on the fire reports. Most of the miscellaneous fires were caused by persons smoking bees or game out of trees or by children playing with matches. A comparison of tables 2 and 3 reveals that the number of smoker and incendiary fires equals approximately the number of cases on which action was not taken; actually cases on nearly all of these fires could not be initiated because of lack of evidence.

TABLE 3.—*Causes of 51 fires on the Cumberland National Forest in 1945*

District	Railroads	Lumbering	Campfires	Smokers	Debris burning	Incendiary	Miscellaneous	Total
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
A				8			4	12
B				3	2	2		7
C	1	1		2	1	1		6
D	6		4	4	1	6	5	26
Total	7	1	4	17	4	9	9	51

Before drawing conclusions concerning the time needed for law enforcement, a number of other factors must be examined. All of the following factors affect the amount of time required to process cases:

1. As mentioned before, most of the time used was spent on the easiest fires to solve. There was not adequate time for investigations because of the press of nonfire work or fire work other than law enforcement.

2. All the criminal cases in the study were brought into county courts; not one went into Federal Court or State Circuit Court. Thus, the long hours necessary to write up and prosecute cases in higher courts were not expended. Some cases should undoubtedly have gone

into these higher courts. In many of the county court cases the defendant voluntarily pled guilty before the county judge or a magistrate.

3. Two men working together will often get better results, but will increase the hours per case. In many of the fires on the Cumberland National Forest only one investigator was used because of lack of time, personnel, etc. In only one or two fires were there more than two investigators.

4. Often the investigator was also the fire boss and could not devote full time to law enforcement. This meant that some travel was charged to suppression.

5. A certain amount of dislike for this kind of work cuts down the time spent.

6. Supervisor and staff time above ranger grade was essential in processing the 51 cases, but is not included in the tables.

7. Some time actually used was probably not entered in diaries from which the statistics were taken. However, most of the men who investigated the fires were contacted personally by the writer with regard to such omissions.

8. In computing a yearly load for a unit, time must be added for investigating false alarms and nonreportable and nonactionable fires, none of which were included in this study. The writer has investigated and prosecuted nonreportable cases that required as much time as reportable ones.

Summary and Conclusions

A summary of these data shows that on the Cumberland National Forest in 1945, rangers and guards spent 13.7 hours per fire to investigate 51 fires and to prosecute or settle 26 of them. Even then, not one true "firebug"—a malicious incendiary—was caught! Eight and five-tenths hours of the 13.7 were spent on actual field work.

The frequency rate for reportable fires dropped below 10 per 100,000 acres protected in 1943, 1944, and 1945. Only in 1945 did the area burned drop below one tenth of 1 percent. As of May 15, 1946, there has been an increase in fires and the number may again go above 10 per 100,000 acres. However, the effect of law enforcement work on reduction in the number of fires is subject to factors not described in this article and must be treated separately.

It is safe to conclude, however, that if every man-caused fire is to be thoroughly investigated, more than 13.7 hours per case must be devoted to the job. Just how much more time will be needed must be determined by further study. Records show that 30 to 50 hours are required to investigate the more difficult individual cases; cases in Federal Court take even more time. The writer's observation is that the 13.7 hours should be doubled at least.

Perhaps more important than attempting to fix a certain number of hours as necessary for the investigation of a fire case is the need for administrators to recognize that *more time* must be allocated to law enforcement activities. When it is realized that some units—as large as States—are "initiating" only one-tenth of their actionable fires, a revision of priorities appears to be in order.

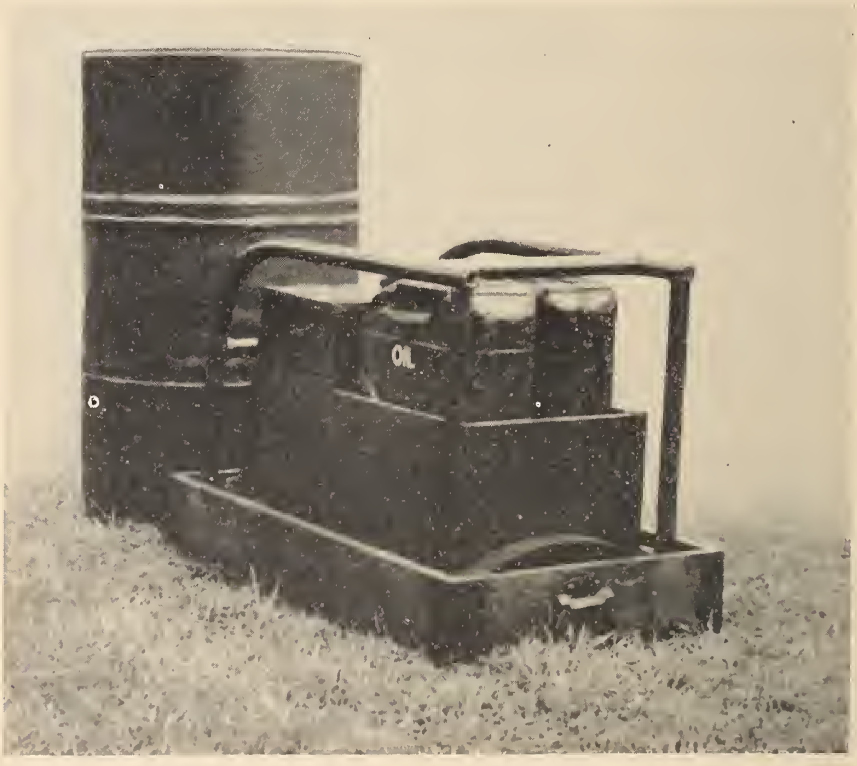
FOREST-FIRE GASOLINE AND OIL KIT

FRED G. AMES

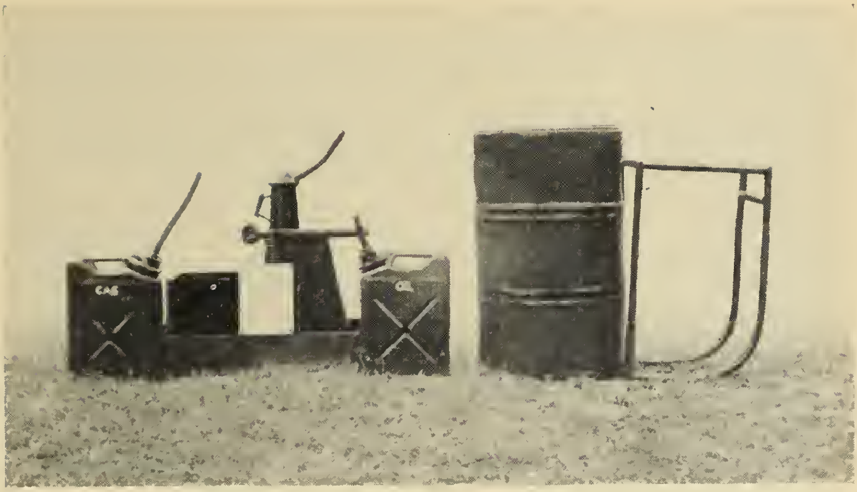
Ranger, Ocala National Forest, U. S. Forest Service

All the items necessary for transporting gasoline and oil to going fires and transferring clean oil and gas to equipment on the fire line are contained in a kit devised by the writer for the Ocala National Forest.

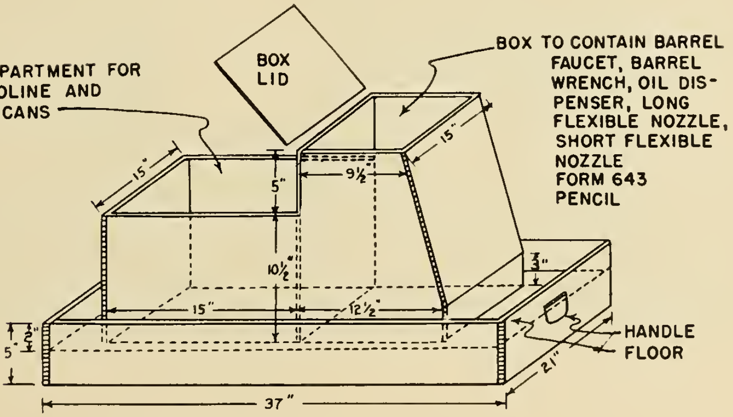
The unit is packed in two parts for transportation: (1) a steel barrel, and (2) cans, barrel jack, and accessories carrier. Two standard 5-gallon Army gasoline cans (U. S. W42, Monark or Nesco, 13 inches wide × 6½ inches thick) are used for the gasoline and lubricating oil, and are packed in the open compartment of the carrier. The use of Army type gasoline cans makes packing very simple. The closed compartment contains a barrel faucet, combination wrench, oil dispenser, one flexible nozzle for the gasoline can, one short nozzle for the lubricating oil can, Form 643 (gas and oil issue sheet), and a pencil. The barrel jack is inverted and placed down over the open

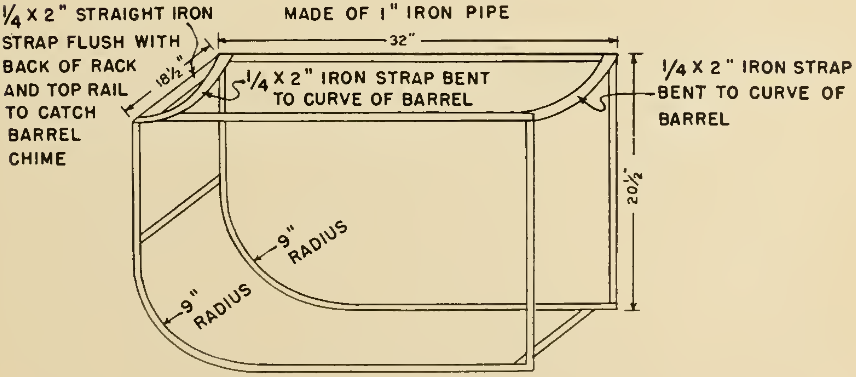


Complete servicing unit packed in two parts for transportation to fire line.



Servicing outfit disassembled to show individual items.

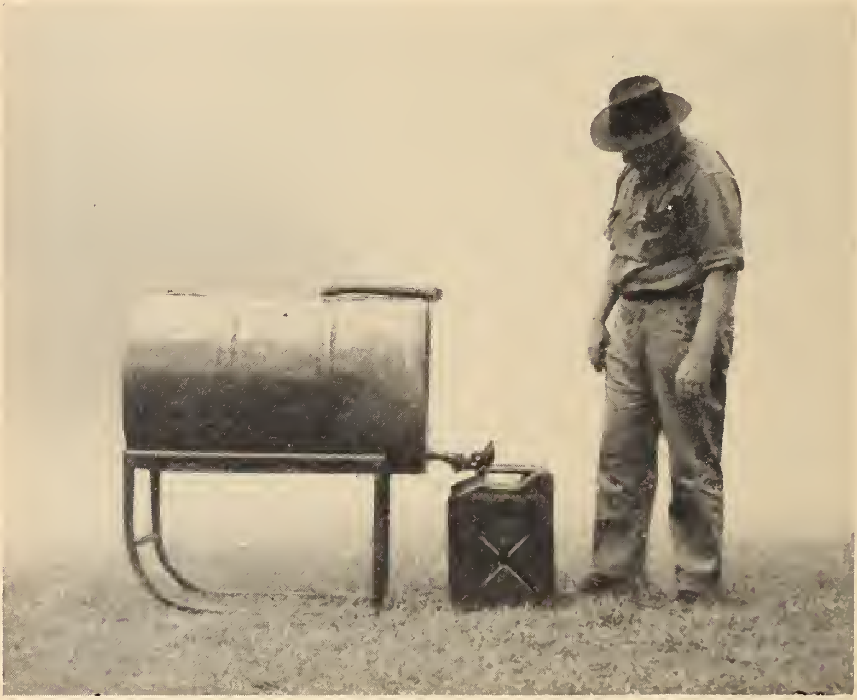

COMPARTMENT FOR GASOLINE AND OIL CANS
BOX LID
BOX TO CONTAIN BARREL FAUCET, BARREL WRENCH, OIL DISPENSER, LONG FLEXIBLE NOZZLE, SHORT FLEXIBLE NOZZLE FORM 643 PENCIL
15"
15"
5"
9½"
10½"
15"
12½"
3"
HANDLE
FLOOR
2"
5"
21"
37"


¼ X 2" STRAIGHT IRON STRAP FLUSH WITH BACK OF RACK AND TOP RAIL TO CATCH BARREL CHIME
MADE OF 1" IRON PIPE
32"
18½"
¼ X 2" IRON STRAP BENT TO CURVE OF BARREL
¼ X 2" IRON STRAP BENT TO CURVE OF BARREL
20½"
9" RADIUS
9" RADIUS

Plan for constructing gasoline and oil kit.

and closed compartments of the carrier and rests in the space between the compartments and the sides of the carrier.

To use the barrel jack, stand the barrel on end and screw in the faucet. Place the barrel jack on end and slip the iron strap on the rear end of the jack under the edge of the barrel (chime), pull the top of the barrel forward until it and the jack are in a horizontal position. The curved runners of the jack serve as a fulcrum.

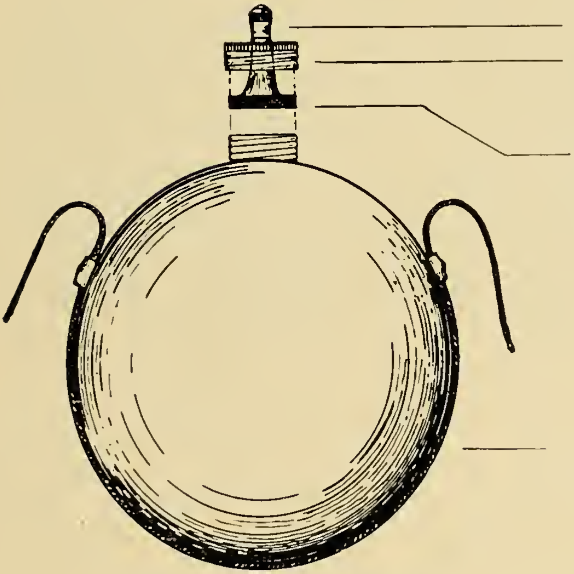


Gasoline being transferred to Army-type safety can.

METHOD FOR REPAIR OF CANTEENS

DEAN M. EARL

Forest Ranger, Apache National Forest



Valve stem cut from discarded tube.

Canteen cap - drill $\frac{1}{2}$" hole or size to accommodate valve stem. Discard original gasket in canteen cap.

Cut base of valve stem to form gasket fitting snugly in canteen cap.

One gallon standard canteen, canvas or cloth covered.

Purpose: To restore capacity of dented and crushed canteens. To locate leaks for resoldering.

Method: Restore shape and capacity

Prepare a new or good canteen cap as above. Screw snugly onto canteen. Apply air pressure from foot pump or air line. When pressure forces sides back to approximate original shape tap with light hammer to remove irregularities. This can be done without removing cover.

Leaks

Remove cover. Apply light pressure. Place in tub of water. Mark leaks and resolder. Replace cover.

HOT FOOD FOR FIRE FIGHTERS

R. H. Williams

Supply and Transportation Officer, Los Angeles County Department of Forester and Fire Warden

One of the toughest problems encountered in fighting brush and forest fires is the provision of adequate food for fire fighters. The difficulties are varied, depending on the size of the fire and the nature of the terrain. On large fires, personnel are frequently located on sectors remote from the base camp. This increases the responsibilities and problems of the supply officer.

We all realize that fire fighting is an exhausting physical activity. Yet very little progress has been made in improving the physical comfort of the fire fighter. Our fire-fighting facilities have been built up by the development and acquisition of the latest types of equipment, and rightly so. However, we are still largely dependent on manpower; and the best tool in the world is only as good as the operator. Therefore, it is imperative to provide good physical conditions and comforts for our fire fighters.

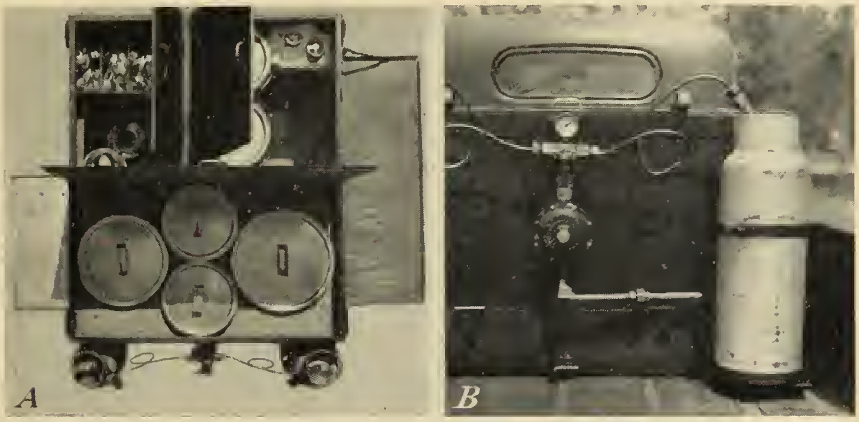
The feeding of personnel on fire-line duty has largely been a secondary consideration. In most cases fire fighters receive little or nothing to eat between the times of departure from and return to the fire camp. To alleviate this condition this department has taken steps to provide hot, nourishing meals to all personnel while on actual fire-line duty.

Portable Army field mess units and the Red Cross doughnut wagons were studied for possible adaptation to this purpose. After much thought and consideration it was decided that a portable unit, based on the steam-table principle, would be the most practicable. This unit was to be a skid type and of a size easy to handle and use on a half-ton pick-up truck. It was also to be capable of carrying food and the necessary equipment for serving approximately 100 men. All food would be prepared at the main camp. Our first construction problem was getting the necessary galvanized sheet iron, which at the time was practically nonexistent on the market. However, with the little material we had on hand, plus the results of a diligent search of used-stock piles, sufficient supplies were assembled for the job. Frank C. Barnes, the department's fire equipment repairman, was assigned to work out a unit based on the steam-table principle.

Some idea of its construction and lay-out may be obtained from the accompanying pictures. The writer will be glad to send interested persons prints showing details of construction of the unit.

One-half of the unit consists of a hot food compartment. This section is double-walled and interlined with ½-inch asbestos sheeting. It contains four stock pots—two 3-gallon, one 6-gallon, and one 9-

gallon. These pots are submerged to about two-thirds of their depth in a chamber containing approximately 22 gallons of water. This chamber is provided with a splash plate and several baffle plates to prevent surge. Actual practice has shown that better results are obtained when the chamber is filled with hot water. The water is maintained at a proper temperature by three gas burners supplied with fuel from two 9-pound cylinders of propane gas. The other half of the unit is divided into two compartments. One, insulated with Compo Board, contains two 3-gallon stock pots for juices; the rest of this compartment is used for storing bread, sugar, salt, etc. The other compartment carries necessary utensils: cups, forks, knives, spoons, etc. All compartments are equipped with night lights connected with the truck electrical system. The over-all dimensions of this unit are: width, 40 inches; length, 48 inches; and depth, 24 inches. The unladen weight is approximately 400 pounds.



Portable mess unit: *A*, view from above showing utensil and cold food compartment, hot food compartment, and the two cylinders of propane gas; *B*, end view showing equipment for maintaining proper temperature of water in hot food compartment.

We have used this unit on several fires with most satisfactory results. In fact, we believe so sincerely that this type of unit will have a very definite place in our future program that we plan to construct another one for use during the coming fire season.

THE F. B. I. COOPERATES WITH THE FOREST SERVICE IN FIRE PREVENTION

B. F. Seizert

District Ranger, Talladega District, Alabama National Forest

In accordance with an understanding reached during the winter of 1945–46, the F. B. I. is increasing its cooperation with the Forest Service in fire prevention and law enforcement. Ranger B. F. Seizert of the Talladega District, Alabama National Forest, reports on action taken by the F. B. I. at the request of the Forest Service. While the action did not result in immediate trials and convictions, it is expected that some will follow. The real test of its value, however, will be the answer to the question, "How much fire prevention did the action buy?" In this respect the report is encouraging.

Since the establishment of national forests in Alabama, the Talladega Ranger District of the Alabama National Forest has had more fires annually than any other ranger district in the State. Sixty percent of the fires have occurred in the south half of the district, which coincides in a general way with a section which has had more incendiary fires than any other spot in Alabama. Division of the Talladega District into two parts in October 1945 still left the old "hot spots" in the south district. But, at the same time, it made possible concentration on fire prevention and law enforcement in those communities where fire occurrence had been high.

During the war the number of fires on the Talladega Destrict decreased. Many forest residents left to work in war plants, and there was less use of the forest by hunters. At the close of the war, however, use of the national forest and adjoining areas increased noticeably. Former forest residents returned to their homes, and the application for hunting permits was large. It was natural to fear a marked increase in fires in 1946.

From January 1 to February 20, 1946, 20 fires occurred, 5 of which were definitely of incendiary origin. On February 20, Assistant Supervisor Swarthout and the district ranger called at the Birmingham office of the Federal Bureau of Investigation and discussed the fire situation on the Talladega District with Mr. Roby, Assistant Special Agent in Charge.

Late in the afternoon of February 21, five incendiary sets occurred along a main highway. Assistance was requested from the F. B. I., and within a short time Special Agents Slate and Southworth arrived at district headquarters. The agents were made familiar with the fire history of the district and then, with the ranger, began an investigation of the fires. On the following day while these fires were still being investigated, three more incendiary sets occurred in the same vicinity on the opposite side of the highway. The F. B. I.

agents immediately set up a road block. A large number of persons were interviewed and the people generally became aware that the F. B. I. was trying to find out who was responsible for fires set on national forest lands. Later the agent and the district ranger enlisted the cooperation of local law enforcement officers and made plans for road blocks and other assistance. The agents continued their investigation of the fires and their interviews with local people throughout the week.

The agents were most cooperative and helpful, and the ranger working with them learned new angles of investigative and law enforcement work. Through their contacts with local individuals, the agents were able also to pass on to the district ranger some good leads for future fire prevention work. These ideas were used later in spot announcements and broadcasts from the local radio station. Up to this time no more fires have occurred along this highway.

On March 1, following a number of incendiary fires, the district ranger again called on the F. B. I. for assistance. This time the fire was in a community where it has been the usual thing for incendiary fires to burn off a large area each year. Special Agent Slate investigated the fire the next day, and key individuals and suspects in the area were contacted. Since this investigation by the F. B. I. agent, neither incendiary nor any other fires have occurred in this immediate vicinity.

Fifty-seven man-caused fires occurred on the Talladega District between January 1 and April 29, 1946. Twenty of these fires were definitely of incendiary origin. Since March 14, however, there have been no incendiary fires on the area.

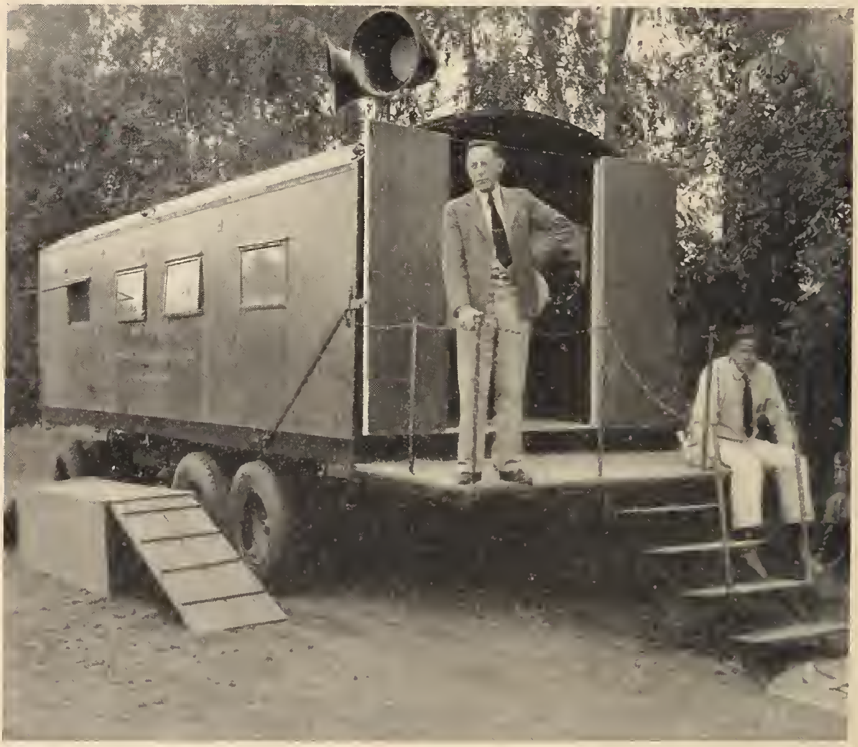
From April 17 to 19, F. B. I. Agent Hartley and the district ranger conducted a joint crime and fire prevention campaign at 14 schools in and near the Talladega Ranger District. A total of 3,225 students and teachers were reached. One of the subjects discussed was the jurisdiction of the Federal Bureau of Investigation over national forest lands. The campaign resulted in increased interest in the work of both the Federal Bureau of Investigation and the Forest Service. It was a "trial run," but judging from the interest displayed by both students and teachers it was very successful. Tentative plans have been made for another cooperative tour of the same kind at the beginning of the school year in the fall of 1946.

FIRE-CAMP TRAILER

Leslie S. Percey

Forestry Construction Superintendent, Los Angeles County Department of Forester and Fire Warden

During the past 25 years, the Los Angeles County Department of Forester and Fire Warden has been active in the development of equipment and methods to cope more effectively with the ever-present fire problem. These efforts have not been confined to fire-fighting equipment alone, but have been applied to the improvement of all phases of fire operations. The development of an efficient fire camp set-up has not been overlooked. Perhaps the facility usually given the least attention is the fire-camp operations office. Not so many years ago, it was considered that a few packing boxes or shipping cases would suffice. Later, a tent was added. Both were crude and

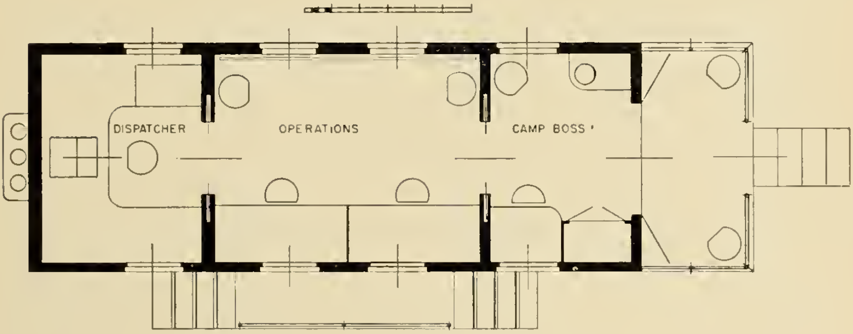


Chief Fire Warden addressing fire school from folding platform at rear of fire-camp trailer office.

afforded little or no protection from wind, dust, and cold nights, and the clerical work of the fire camp reflected the lack of equipment planning.

Then came the Civilian Conservation Corps and similar programs, effecting the construction of a transportation network of fire motorways and truck trails, which wrote finis to the reliance on pack trains to supply fire camps on fires in territory under the jurisdiction of this department. When two-way radio was installed in all fire apparatus, it became apparent that an improved fire-camp field office was essential to efficiently handle dispatching and clerical work under all climatic conditions.

At this point, Chief Spence D. Turner directed the Department's construction division to design and construct a fire-camp trailer—an office on wheels to accommodate the fire-camp boss and house the dispatcher, timekeeper, and clerical force. The author held several conferences with fire-camp dispatchers, timekeepers, and fieldmen usually assigned to the fire camp to obtain their ideas and recommendations. On this basis, the fire-camp trailer was developed.



Floor plan of fire-camp trailer office.

Since funds were limited, it was necessary to start with a large cargo trailer made available by another department. On this was constructed a three-room office with insulated exterior walls, ceiling, and floor, and insulated partitions with sliding doors.

The forward compartment is designed as a communications office, in which is installed the PBX switchboard, teletype, two-way radio, and public address system. The middle section is constructed with built-in desks, drawers and cabinets for forms and stationery, maps, and dispatcher's operations board. The rear compartment is the office of the fire-camp boss. All offices are lighted with electricity, heated by butane wall heaters, ventilated with electric fans, and interconnected by telephone. Since many of the worst fires in Southern California occur in the fall months, the heating arrangement is very much appreciated by those assigned to fire-camp office operations. The fire-camp trailer is a proven success and provides a complete field office for maximum operating efficiency in dealing with fires and major disasters in any kind of weather.

FOREST FIRE FIGHTING EQUIPMENT DEMONSTRATION

Division of State Cooperative Fire Control—Washington Office, U. S. Forest Service

Michigan, Wisconsin, and Minnesota were hosts to a group of 73 State and Federal forest fire control men from U. S. Forest Service Regions 7, 8, and 9, from June 10 through 15 of the present year. The purpose of the meeting was to afford an exchange of ideas on fire-fighting equipment, stimulated by field showings of special types of equipment. The 6-day field demonstration was arranged by the Lake States.

Interest was widespread. Fifty-nine State men, who came from Texas, Georgia, and Connecticut, and many of the other States between these widely separated points and the Lake States, were in attendance for the full week.

The group assembled at the Higgins Lake Training School, operated by Michigan's Department of Conservation as a year-round training center for departmental personnel.

Michigan's demonstration ran from noon of June 10 until noon, June 13. Briefly, it included an inspection of forest fire control improvements, such as a regional and district office set-up, a fire equipment shed, the Roscommon fire equipment experiment station, radio laboratory, a remote control radio station, a typical fire tower, and fire prevention practices in an oil field. One day was devoted to a field demonstration of Michigan's mechanical fire-fighting equipment. Enough models were on hand to show the steps in the development of some types of equipment. Michigan featured new plowing units, the sand-throwing trencher, pumping units, backfiring torches, and well-sinking units employing water pressure for drilling. Equipment was shown and demonstrated in a large abandoned field, surrounded by woods. This provided opportunity for showing performance on both open and forested land. Announcements and comments regarding equipment while in operation were made over loud speakers mounted on a sound truck. (This feature added much to the clarity and speed of running the demonstration.)

En route to Wisconsin short stops were made at old burned areas, the Central Repair and Sign Shop at Gaylord, and the Escanaba District Headquarters. A field demonstration of building fire lines with a bulldozer in a heavy slash and blowdown area was also seen.

Wisconsin fieldmen took over at Norway, Mich., near the State line. On the way to Eagle River, stops were made at a typical Wisconsin State ranger station, a lookout tower, and the plant of the Goodman Lumber Co.

The Wisconsin Conservation Department arranged with the "Trees for Tomorrow" organization to house and feed the group at its Eagle River Conservation Training Camp leased from the United States

Forest Service. Both here and at Higgins Lake, accomodations and food were excellent.

The demonstration of Wisconsin's fire-fighting equipment was held in a natural amphitheatre, with a truck trail running on a contour along the foot of the slope. The audience sat on the ground or in an improvised bleacher on the slope of the hill. Each piece to be demonstrated was brought in along the truck trail from around the hill, unloaded, and put to work in the valley where everyone could see it. This demonstration covered tilting bed trailers, the chain saw, and various types of plowing and pumper units. Here also, announcements were made from a sound truck. Following the demonstration, equipment was parked conveniently for inspection.

On the way to Tomahawk a stop was made for a demonstration of Wisconsin's new seedling planting machine.

At Tomahawk, Wis., the men were shown through the State's forest protection headquarters, central warehouse, and shops. Also, Minnesota personnel demonstrated some of their portable and semiportable water-pumping equipment here. This wound up the demonstrations. Because of lack of time and since much of Minnesota's heavy equipment is similar to that of Wisconsin, it was considered unnecessary to transport the heavier pieces to Wisconsin for display or demonstration.

The week of demonstrations and the swapping of ideas and experiences was exceptionally worth while. Many of the men expressed the hope that other intersectional fire equipment meetings would follow. The Lake States have set a very high standard as hosts and as efficient builders and demonstrators of equipment. They are to be congratulated on staging a show which will prove highly beneficial to those who attended.

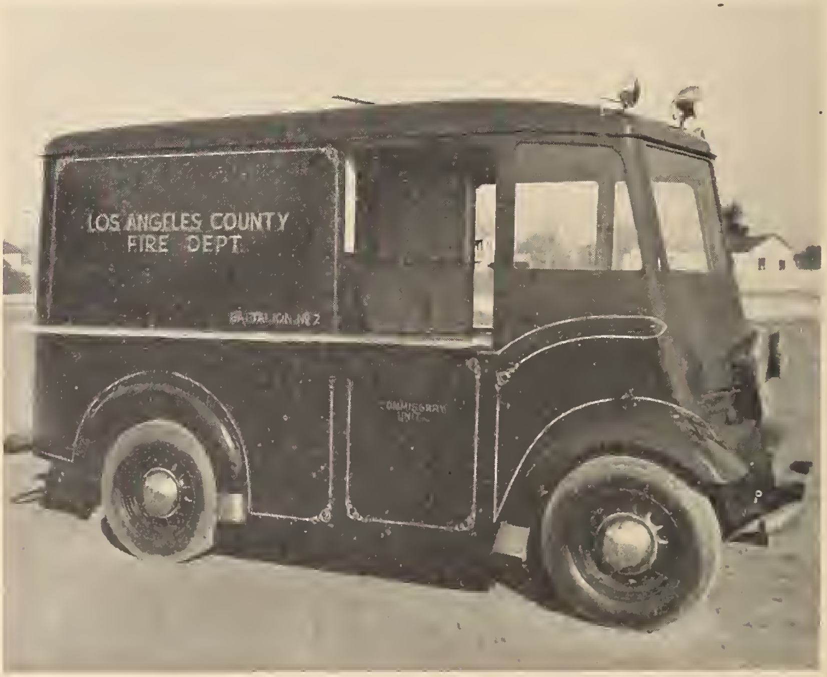
A CONVERTED MILK TRUCK MAKES A HOT-FOOD DISPENSER

K. E. Klinger

Battalion Chief, Los Angeles County Fire Department

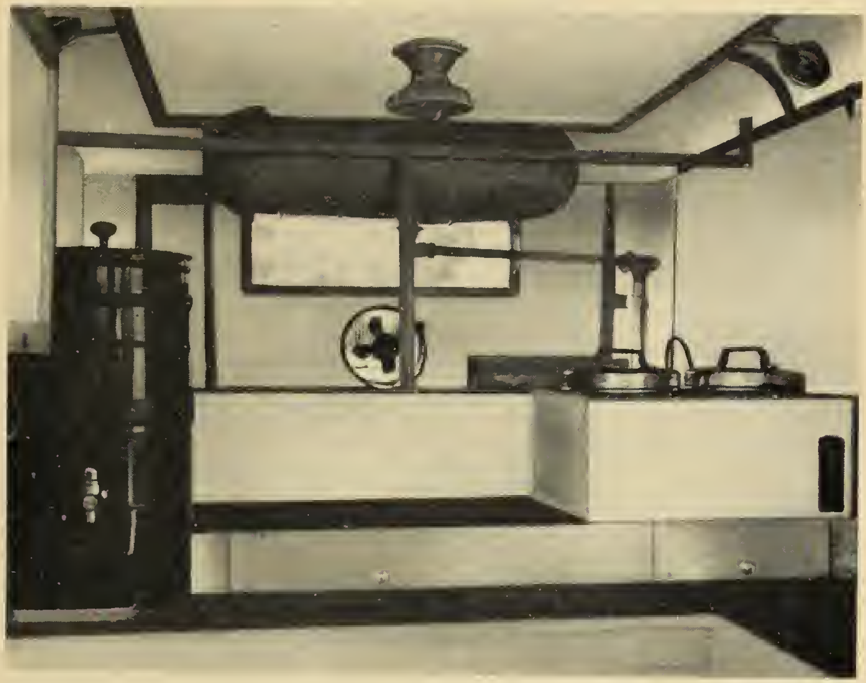
It has been recognized for years that fire fighters on prolonged fire duty miss many meals, which results in lowered efficiency. In the fall of 1944, the members of Battalion 2, Los Angeles County Fire Department decided to do something about it. They were tired of eating cold sandwiches and drinking lukewarm coffee while fighting stubborn fires. Each member donating toward the cost, they purchased a 1936 four-cylinder Stutz package car, formerly used as a milk truck. The men steam-cleaned the truck, overhauled the motor and chassis, repainted the body inside and out, and fitted it up for a kitchen.

A steam table was built from old boiler plate and ice cream containers, and a hot plate and two-burner gas plate, made from old stove parts from junk yards, were installed. Fuel enough for several



Traveling commissary.

days' continuous use was supplied from a butane tank. A 6-gallon butane coffee urn was donated and installed, and a 22-gallon water tank gravity flow connected to a faucet and sink supplied water for cooking and dishwashing. Other equipment included was a 25-pound capacity ice box, an electric fan for ventilation, a lighting system for 110 volts from Home-lite generator or domestic outlets, and a supplemental 6-volt lighting system. The truck has all the conveniences of an up-to-date kitchen and ample room for storage of food and dishes. The outside of the truck body carries brackets to which detachable counters can be fastened for serving purposes.



Interior of traveling commissary showing coffee urn, hot-food dispenser, steam table, and grill.

This commissary unit was rebuilt and financed entirely by members of battalion 2. They presented it to the Department for use in battalion 2 area, and the County Board of Supervisors accepted it with thanks.

BUILDING A COOPERATIVE TANKER

A. G. Randall

District Ranger, Harney National Forest

The Volunteer Fire Department of Hot Springs, in the Black Hills of South Dakota, is now using a forest fire tank truck which shows what can be done with a limited amount of money. Building the tanker was a joint undertaking of the fire department and the Harney National Forest.

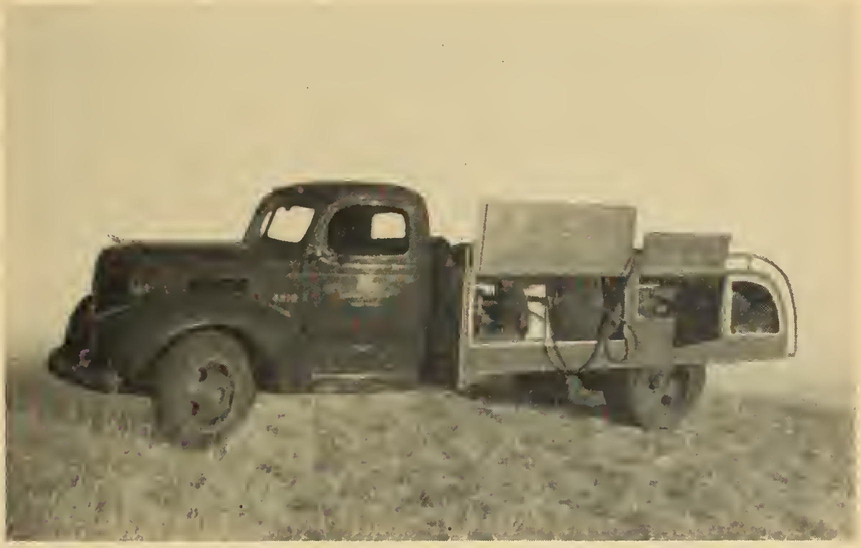
The department, founded in 1890, not only has done a good job taking care of the city of Hot Springs, but also has fought both farm and range fires in the surrounding country. In 1938, land west of Hot Springs was added to the Harney Forest so that grass and timber cover on a vital watershed might have better protection from fire. It was natural that the Hot Springs fire department and the Forest Service should work together.

In October 1944, the Forest Service made available a Dodge ton-and-a-half truck chassis and a Bingham Type Z portable pumper. The Hot Springs fire department undertook to build a tanker body as streamlined and efficient as its other equipment, which includes a powerful modern pumper; booster tank-pumper; a well-equipped hook, ladder, and salvage truck; a pick-up-mounted smoke extractor designed and built by the department; and an iron lung.

Materials were obtained at little or no cost from various sources. Steel, consisting mostly of ¼-inch bridge tread material, came chiefly from Fall River County. The department employed one of its members, an experienced welder. Other members helped cut the steel in their spare time. Chief Victor C. Englebert did most of the designing and led in carrying on the work.

The central part of the body is a rectangular steel tank, 3 x 2 x 9½ feet, holding slightly more than 400 gallons of water. It is fitted with three bulkheads to prevent surge and is coated inside with anti-rust compound. The bottom is supported by 2-inch planking, resting on the truck frame and held in place by flanges. On either side, cabinets were constructed with tops and bottoms flush with the tank, except that the bottoms over the hind wheels were necessarily raised. The cabinets were made 24 inches wide to give the whole body the width of a standard truck platform. The body has perpendicular sides and a flat deck. The rear is rounded to give a streamlined appearance. The sides are dropped 7 inches and have hinged sections, which may be raised to change tires. The cabinets are framed with ⅛-inch steel and the covers with ½-inch angle iron.

The body is welded throughout to form a solid unit, which is fastened to the truck frame by means of four U-bolts. It can be changed readily from one chassis to another. The edges of the body have a bead of ½-inch pipe, and the deck is surmounted by a railing of 1-inch pipe at a height of 6 inches. Steps are provided in the rear, making it possible to carry extra men. The sides are painted red and the deck, aluminum. The green cab has been retained. The colors give the truck a pleasing appearance. The side sections covering the cabinets are hinged at the top. They are held shut by slide bolt fasteners and may be held up by wing nuts which fasten them to the railing. The cabinets are painted aluminum inside and are provided with outlet boxes for lights. The truck carries an electric siren. The fire department spent some $450 of its funds but now operates a unit which it estimates would cost $1,500 if purchased from a manufacturer. This estimate does not include the chassis and equipment furnished by the Forest Service.



Hot Springs tanker with cabinets open, showing Bingham pump in first compartment, pump accessories in second, and hand tools in tail section. Hoses are shown attached at the pump. Reels have been installed since this picture was taken.

The Bingham pump is mounted in the front left-hand cabinet. Its fuel tank is on top of the deck, immediately behind the cab. Pipes and valves are so arranged that water can be pumped into the tank from a suction hose or under pressure to 1½ or ¾-inch outlets. A bypass is provided so pressure can be regulated. Back-pack pumps can be filled from the tank by gravity. There is a filling dome on top of the tank so that any source of water can be used. The department prefers an independent pump motor to a power take-off from the truck motor, because pump pressure can be maintained while the speed of the truck is varied as needed.

The unit has two ¾-inch rubber hoses mounted on live reels. "Stayput" hose couplings keep the pressure from forcing the hose off the connections. Instead of conventional nozzles, the hoses have been fitted with adjustable shower heads, mounted on pipes 6 feet long for convenient handling. To avoid wasting water or stopping the pump, these can be thrust temporarily into the top dome. In this vicinity, fuels are generally light. Therefore, use of the ¾-inch hoses gives adequate wetting, and 2 to 3 miles of fire edge in grass can be controlled with one load of water. The shower heads can be adjusted to give a very fine spray, approaching a fog. This had a powerful extinguishing effect, even when tried experimentally on an oil fire. Nozzle operators may either ride on the truck or walk alongside. One or two men with shovels should follow the truck, since it is possible to miss small spots which may flare up, particularly if the truck is moving fairly fast and the nozzle men are riding. Actually, no trouble has been experienced so far from the survival of small spots, the wetting apparently being sufficient to extinguish fire in grass completely. Fire is quickly knocked down in fuels such as dry sweet clover, where flames often leap 10 feet in the air. In this type, the truck travels more slowly than in grass. The truck also carries 1,000 feet of 1½-inch linen hose. The main use of this hose is expected to be on fires which the truck cannot approach directly because of rimrock, etc. The 1,000 feet of hose may either reach the fire or materially shorten the distance to fill back-pack cans. Of course, many uses may be found for an extra 1½-inch line on both rural and urban fires.

In addition to the equipment already mentioned, the truck carries in the cabinets 5 back-pack pumps, 3 Pulaskis, 4 McLeods, 3 axes, 3 picks, 27 shovels, tarpaulin, first-aid chest, and bolt-cutters for getting through wire fences. Both Forest Service and State tools are included. Although the tools do not make a balanced unit, the truck is ready for almost any situation.

The truck is kept in the fire station with the other equipment, ready to go at all times. Since grass fires may occur in below freezing weather, storage in a heated garage is particularly valuable.

The operation and use of the truck is covered by a cooperative agreement between the Forest Service and the Volunteer Fire Department. The agreement also provides that equipment furnished by each agency shall remain its own property. The pooled equipment is providing, in the southern Black Hills, a highly valuable fire control unit with which both parties are highly pleased.

THE LOUISIANA FIRE JEEP

Louisiana Forestry Commission, Baton Rouge, La.

From the earliest use of the jeep by the Army, the fire control men of the Louisiana Forestry Commission were interested in it. They watched thousands of jeeps brought into army training centers in Louisiana and saw them swarm along the highways and through the woods, traveling through seemingly impassable areas. In July 1944, the report of Maj. A. C. Rowland on "Development of Forest Fire Fighting Equipment,"[1] issued by the Forestry Branch of the Army Air Forces Proving Ground Command at Eglin Field, Fla., through the Forest Service, called the attention of the commission to further development of the jeep. Finally, in November 1945, the commission purchased one of the first civilian jeeps sold in Louisiana.

It was the idea of the commission to make a fire-fighting unit out of this jeep. Major Rowland's conclusions as to the combination of equipment were valuable, but the problem of the commission was

The four-wheel drive, low-range gears, snow- and mud-grip tires, and driver skill enable the jeep to climb steep slopes in the woods.

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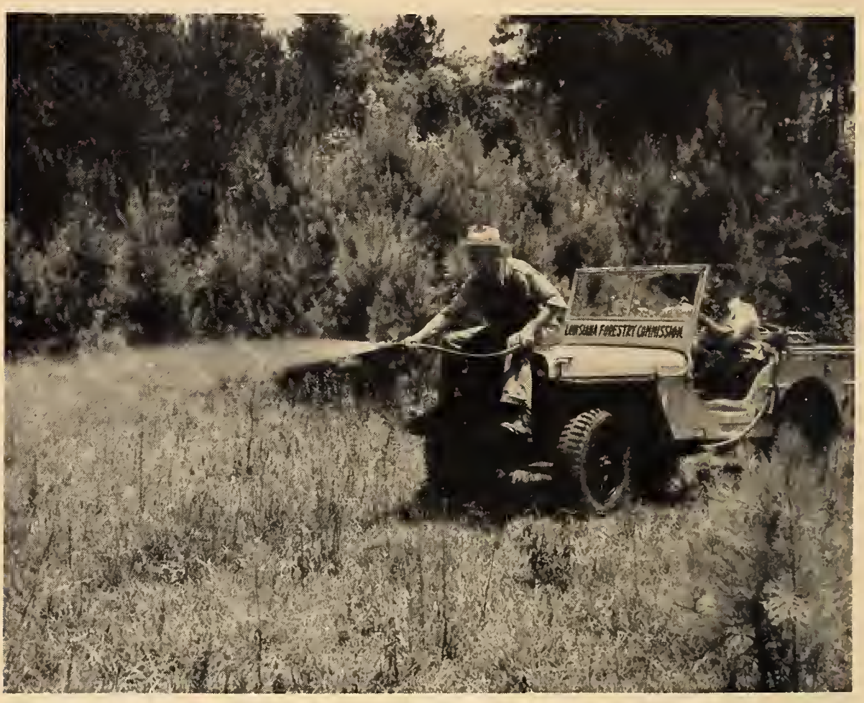
[1] See condensation of report in FIRE CONTROL NOTES, 7 (1): 6. 1946.

the installation of a Panama pump on the truck. This was done successfully by the men at the central repair shop on the Alexander State Forest. The pump was mounted on a sturdy, hand-made bracket bolted to the head of the engine on the forward right side and driven by a belt from a double pulley mounted at the forward end of the crankshaft. A 70-gallon water tank was mounted in the rear compartment of the jeep. Thirty feet of "spray" hose and 20 feet of "filler" hose were provided. A second front seat was added. In January 1946, the jeep was assigned to a standard mobile crew area in southwest Louisiana, consisting of approximately 100,000 acres. Some 20,000 acres of this area are planted slash and loblolly pine. On the whole, the unit was more satisfactory than a standard pick-up truck similarly equipped. The one disadvantage was the size of the crew, which because of the higher-mounted water tank had to be limited to three men. Four men is the minimum crew usually employed by the commission.



The hose man varies his position with forest conditions. The stream here is from a forest fog nozzle, which operates at pressures of 80 to 120 pounds. Its spread is satisfactory, its pressure sufficient to give good penetration, and its use of water economical. Because the volume of the stream is small it isn't necessary to speed up the motor. The nozzle exhausts 6½ gallons per minute.

Four standard Army jeeps were bought by the commission in February 1946. A "perfect" factory installation of the Panama pump was made for the jeep by Mr. Speedy Freeman, of the Panama Pump Co., Hattiesburg, Miss. The basic change in the mounting of the pump was a relocation to the left side of the engine, with the sturdy mounting bolted to the inside of the fender and reinforced with a steel plate on the under side. The bypass was removed from the pump and placed on the water tank. The pump was still driven by belt from a double pulley on the front of the crankshaft, an arrangement which made more room under the hood. A tank was also installed on the jeep by the Panama Pump Co. It has a reduced capacity of 55 gallons, which gives a lower center of gravity and better riding space for extra crew members.

The first standard Army jeep was equipped and delivered for test in April 1946. Although the spring fire season was almost over, an immediate test period was set up to determine the use of this unit on special fires. It was used on control-burning projects and several large fires. As a fire unit, it has been highly satisfactory, though usage has been limited and no statistical data are available.

All of the units are to be equipped identically with the unit developed by the Panama Pump Co. Standard Army quarter-ton trailers have also been purchased. They will be equipped with water tanks having a capacity of from 150 to 200 gallons. They will be towed by the jeep to fires and dropped where travel is no longer practical. This extra, readily accessible water will supplement the small supply carried in the jeep-mounted 55-gallon tank.

At present the Louisiana Forestry Commission feels that the Louisiana Fire Jeep is the most valuable piece of fire-fighting equipment that can be used on small areas and to supplement the work of heavier types of equipment in larger areas. It will carry the two-way radio equipment at present being installed in the communication set-up. As equipped, the unit will be fast moving, highly mobile, and good for reconnaissance work. It can reach a fire in the early stage, scout the area, and attack the blaze. Where necessary, it will be reinforced with a second line of heavier equipment and more men.

The illustrations which accompany the article are of the standard Army jeep equipped by the Panama Pump Co.

Specifications for the Louisiana Fire Jeep

Type: Truck, ¼-ton, 4 x 4.

Cost:

	Civilian	*Army*
Truck	$1,220.11	$912.20
Pump and tank	196.20	191.60
Top		52.96
Paint		35.00
	1,416.31	1,191.76

NOTE.—The four Army jeeps purchased did not have tops when delivered and it was necessary to paint them. Two were new and two were used, with 12,000 and 14,000 miles reading on the speedometers.

Measurements:	*Inches*
Length	122¾
Width	59
Height (windshield up)	67⅜
Height (windshield down)	52⅜
Ground clearance	8⅝
Tire tread	48¼
Wheelbase	80
Tire size	6.00 x 16

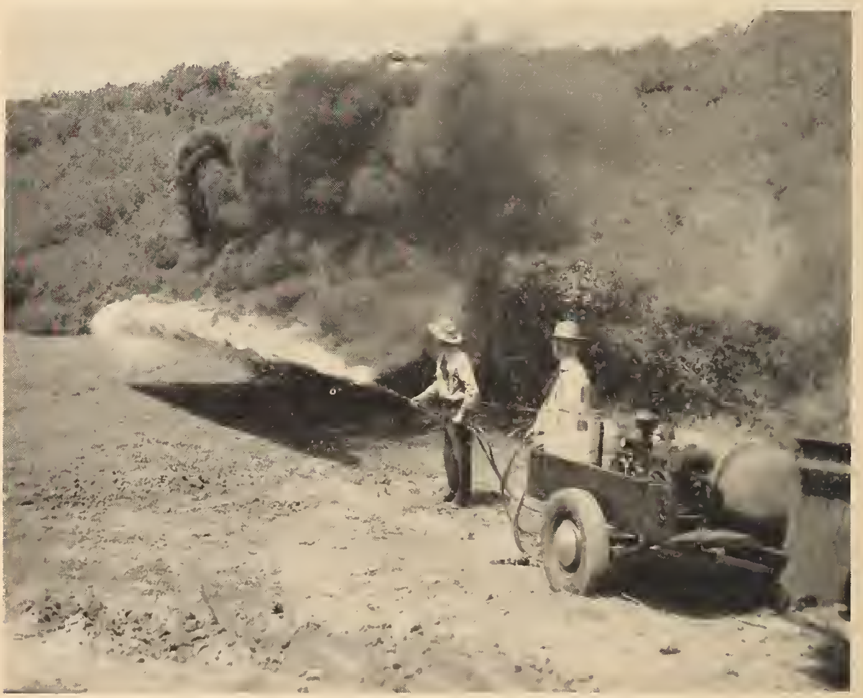
Weights:	*Pounds*
Shipping weight	2,120
Curb weight	2,220
With equipment, full water tank, 2 men at 150 pounds	3,090

A NEW MOBILE FLAME THROWER

HENRY WERTZ, JR. *and* C. VERNON MAY
Los Angeles County Department of Forester and Fire Warden

Some time ago, Spence D. Turner, County Forester and Fire Warden, appointed a committee to study the problem of developing a better backfiring torch. With his encouragement, the writers worked out a combination butane-Diesel flame thrower which gives promise of being a valuable addition to fire control equipment. Several of the new units are now in use. It is hoped that they will be capable of backfiring cover more thoroughly on watersheds similar to those of Los Angeles County.

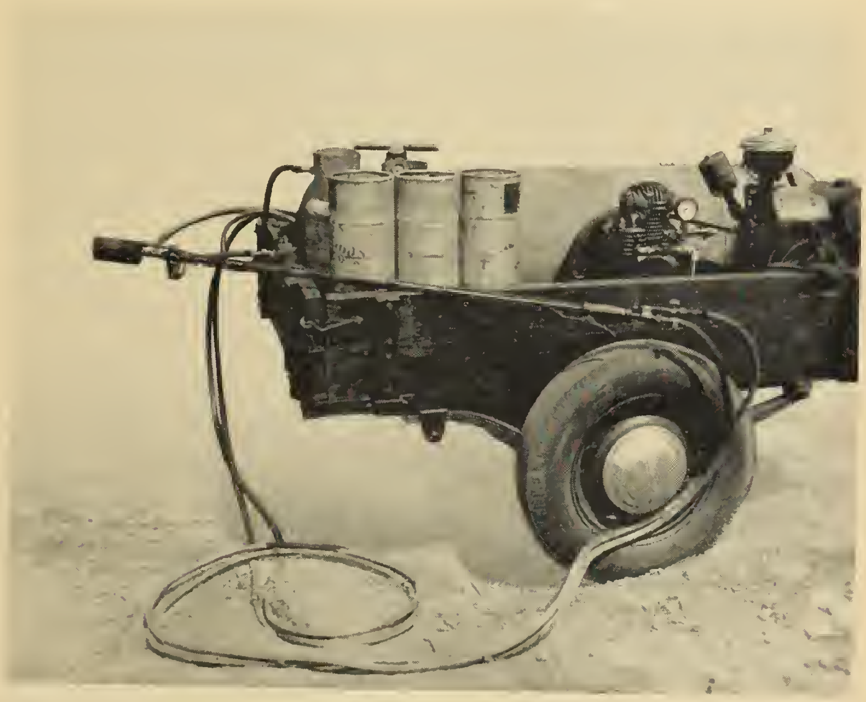
This unit, as shown in the illustration, consists of a gasoline-driven compressor and 70-gallon tank of Diesel oil, a battery of six 10-pound butane tanks connected to a manifold, 75 feet of ⅜-inch oil-resistant hose, and a specially built butane-Diesel flame-throwing gun. The gun is so constructed that the heat of the flame is far enough from the nozzle so no shield is required for the operator. Mounted on a



Fifty-foot flame thrown from portable flame thrower.

two-wheel trailer, it can be towed by truck over fire roads and then by tractor into strategic locations.

Of all volatile fuels with which experiments were made, a combination Diesel oil and butane gas gave the best results. These two fuels were already being used, the former in the tractors, the latter in portable fire-camp kitchens, etc. Jellied gasoline was tried, but it gummed up the pipes, caked the nozzle, and was consumed too rapidly. Liquid gasoline and kerosene tended to burn completely before reaching the maximum distance, leaving no burning substance on the brush or other cover. These three fuels were also unsuitable because their high volatility made them hazardous to personnel in backfiring.



Flame thrower equipment.

When backfiring in light cover such as grass, sage, and greasewood, the butane is used alone. It is capable of throwing a flame a maximum of 4 feet. In heavier materials such as trees and dense green cover, where there is very little dry undergrowth, the combination butane and Diesel oil is used. The operator can throw a mass of flaming fuel over a distance of 50 feet, leaving enough of the slower burning Diesel oil to insure thorough ignition. The heat generated by this torch is so intense that it burns the greenest vegetation cleanly, thus saving many man-hours of line-cutting with hand tools. In the heavier type of cover, more than 300 yards of fire line has been burned over in 19 minutes, using 20 gallons of Diesel fuel.

The mobile unit will be equipped with small portable units operating under the same principle. These will be useful in backfiring the more inaccessible areas.

The portable unit weighs 62 pounds. It has one 10-pound butane tank and a 3-gallon Diesel fuel tank with a hand-operated pump. Attached are 15 feet of oil-resistant hose and a lighter-weight gun than the one used on the mobile unit. It makes a compact unit 12 by 15 by 22 inches with retractable handles. This unit can throw flaming fuel for a maximum of 30 feet. The butane flame will last approximately 3 hours and has a maximum of 4 feet. The Diesel fuel, if used continuously, will last approximately only 3 minutes. However, with the usual intermittent bursts it will cover about 100 yards of fire line in average heavy growth. Back-pack boards are used to transport additional fuel supplies.

The larger mobile unit, operated by a three-man crew, has already been used successfully on several fires. It holds great promise for use when emergency methods are necessary to halt forest or brush fires.

FORESTERS ALOFT IN '46

P. A. Thompson, *Chief, Fire Control Division, U. S. Forest Service, and* D. M. Thompson, *Forest Ecologist, Southwestern Forest and Range Experiment Station, U. S. Forest Service*

The old timer shifted his heavy fire pack from one sweaty position on his aching back to another not quite so chafed and spat a stream of tobacco juice at a disinterested beetle. "Just look at that, would you! I *knew* that confounded smoke would be over on that slope! There she sits—4 hours down into that canyon and out onto that blasted ridge; and from here I can dang near spit on it! If I just had one of those flying machines. * * *" Nobody knows how many times such thoughts have been voiced since the first flight of the Wright brothers excited the imagination of men everywhere.

The history of aviation in the Forest Service has been a history of the struggle between an idea and its practical application. After the last war when men like H. H. Arnold, now General of the Army Air Forces (retired), flew fire patrol over the hills of California, it looked as though the airplane might become a regular piece of Forest Service equipment. However, inadequacy of communication between the ground and the air, plus the general lack of dependability of the airplanes of that day, prevented the development of "idea" into "application." Aerial reconnaissance has long been sporadically adopted as an emergency measure during periods of exceptional fire danger or poor visibility. It was not until the years just prior to World War II, however, that planes began to pay their way in saving of cost and time like any other piece of equipment. And it was not in the direction of detection that they first began to "pay off," but principally in the field of aerial delivery. During the late thirties, food, tools, beds, and supplies of all kinds were dropped on practically all the major blazes in the back country for the use of weary fire fighters thereby saving time, manpower, and pack mules.

The smoke-jumper program which was capturing the popular imagination before the recent war was a natural outgrowth of and a step beyond the cargo-dropping techniques. If supplies could be placed accurately at the site of a blaze, then why not men? Careful pioneering in the forest regions of the Northwest, from 1937 to 1940, had turned this idea into a functioning and highly valuable tool for use where "force enough, fast enough" could not be realized by ground travel.

Extraordinary impetus was given to airmindedness by the second World War. The Forest Service shared in this increasing interest. During the war the size of the smoke-jumper program was greatly expanded in order to conserve manpower. Results were encouraging. The practical use of airplanes in any situation where time, distance, or transport enter the equation is now being carefully studied.

Planned use of aircraft for the whole job of fire detection is being given a thorough try-out in several forest areas. The actual savings effected by the removal of fixed look-outs are applied against the costs of replacement service by planes. Trial runs indicate that in some places, particularly where lightning fires constitute the major risk, real savings are possible, both in money spent and in better protection of the forests.

Herbert K. Harris, office of Fire Control, Northern Forest Region, and William G. Morris, Pacific Northwest Forest Experiment Station, are developing planned programs for selected areas in Washington, Montana, and Idaho. They are studying carefully all phases of the problem, from degree of supplemental aircraft use to analysis of cost data. They are also testing the feasibility of new suggestions and ideas in the field of detection as they are advanced or evolved. They are pretty well satisfied, for example, that fast flying planes which will cover a given area more times in the same period than will slower planes now in use are going to prove more efficient in the long run. This is a somewhat startling new idea. It runs counter to the old theory that slow moving or hovering aircraft are more effective.

It has been proved that where detection coverage in excess of 40 to 50 percent is needed, it can frequently be provided more cheaply by air patrols. And what is more the whole system becomes flexible in its application. Increased flexibility usually means economy and greater efficiency. Where lightning causes nearly all the fires, areas need not be covered until the necessity arises. Ground coverage to be effective must be in place, each lookout manned and waiting before any real storms occur, an excessive use of effort. This is a common situation in the higher mountain ranges of the Northwest. Areas such as the Salmon Range in Idaho, the Bitterroot and Flathead in Montana, and the Chelan in Washington, may lend themselves well to total air-detection systems at the present time. Tests are now going forward as fast as practicable with the men and equipment available. Region 9 is using a float plane for detection over much of the Superior National Forest. One thing is certain—the trend is toward increased air coverage. Just where this will come into balance with fixed ground coverage is something for the future to decide.

Detection values have always been hard to catalogue and analyze. If "force enough, fast enough" is to be attained, detection must be prompt. In a sense then, detection is prevention—prevention of large and costly fires. Like fire insurance, it is hard to justify on a cost basis until there is a blaze. Suppression, on the other hand, is a natural field for wide use of planes. Suppression of going fires which are destroying public timber or forage values, and threatening watershed damage demand the use of any method which will put an immediate end to the danger. Public acceptance of the use of aircraft on going fires has always been prompt. In fact, the public occasionally has gone a step beyond the present capabilities of the aerial equipment in its demands for the use of spectacular methods.

The end of the war brought an increased interest in the aerial phases of forestry. Hundreds of applications have poured in from ex-paratroopers who want to re-experience the thrill of leaping into space high above the earth. Great numbers of school students want to sign up for this "front-line" duty. The smoke-jumper program, already proved successful, is then the first field for postwar expansion.

As originally conceived and worked out, the smoke-jumper squads were small units held in readiness to go into the remote areas of some of the West's most isolated forests. It might take a man on foot a day or more to reach such places. Fires in this type of country too often grew to sizable proportions before the firemen on the ground could reach them. Whole crews of men with pack animals were needed to bring in the tools and supplies. Sometimes it took weeks to put out the last spark, and large areas of timber were scorched and burned.

During the war, when manpower was scarce, smoke-jumper crews were grouped by necessity in larger units for use on big fires. The success of this wider use led the Regional Foresters to set aside several million acres of remote and isolated country. These are now being protected entirely from the air—from the detection of lightning strikes to the suppression of sizable going fires. To date, the smoke jumpers have justified the additional trust.

The speed with which smoke jumpers can be put on a fire holds out hope for solution of the vexing "flash fuels" problem. In relatively accessible areas where large bodies of flash fuels exist, the lag between detection of the smoke and arrival of the first men on the fire has always been discouraging. Blazes on such fuel types can in 30 minutes or less reach a size too large for 1 or 2 men to handle. A fast-acting squad of smoke-jumpers, say 10 to 25 men, can get to fires starting in the grass-brush fringes of the timber bodies and stop them before they reach threatening proportions. If that "first-run" that fire fighters dread can be stopped by fast aerial delivery of sufficient force, then protection in such areas takes a long step forward! There are millions of acres of this type, particularly in Idaho, where the inflammable fringes of the Boise, Salmon, and Payette Forests have been recognized for years as a potential threat to adjacent valuable timberlands.

Taking thought a step further, what has been the experience on large fires in the past? Many fire chiefs have watched helplessly from a ridge top while a sector of their line "blew-up" to start a run into a new drainage. In order to reach this new front, men have had to detour into almost impassable canyons and up steep slopes. They have hiked for hours to reach the point of spread and then arrived too exhausted to be effective! In one such situation last summer, smoke jumpers from an air base more than 50 miles away were used successfully. They arrived at the breakover more quickly than men from the main suppression crew could possibly have done.

The use to which air aids can be put on big fires is easy to visualize. Scouting on any large fire is a vital factor in expedient and adequate use of manpower. New development in air-to-ground communication, using ultra-high frequencies is opening up new possibilities. The fire chief must have accurate information delivered without delay. Photographs taken from the air and developed in a matter of minutes in the plane, can be dropped to the "command post" of the fire boss. This is unquestionably a most effective scouting service. If photographs of the area made prior to the fire are always at hand, showing bodies of fuels and details of terrain not gained from ordinary maps, the overhead on any large fire can direct prompt and accurate action.

It may not be too fantastic to visualize a future fire chief on a project fire, maintaining his daytime control from a plane. Aloft, he may assign ground forces to their sectors, as factors of slope, fuel type, and wind, change the picture; and dispatch smoke-jumper units to "spot fires" out ahead of the main fire or to sectors of critical need as they develop.

Air freighting into the back country or cargo dropping may be more prosaic, but it is just as essential a part of the whole aerial picture. As previously brought out, it was in this phase that the airplane first began to pay dividends in savings to the public treasury. In 1945, three-quarters of a million pounds of tools, equipment, and supplies were dropped to camps by parachutes or put on back-country landing strips by air delivery. Crews going in to fires have been able to "travel light" and find food and tools on the spot. This lessens the fatigue factor and is a vital addition to the straight saving in delivery time and cost. Firemen can be "serviced" cheaply by light airplanes where the pilot doubles as dropper. Tossing out a 35- to 50-pound pack to a one- or two-man crew at the scene of action can effect great savings in the use of highly trained personnel.

The use of expendable equipment on fires is increasing. Delivery of hot food to crews is an accomplished feat, and the use of paper food containers obviates the necessity of packing out anything but beds and tools. Experiments with the use of paper beds indicate that before long beds too may be expendable. Crews who come off a fire with nothing in their hands but the tools with which they work will obviously be ready to go on more quickly to another blaze.

Extensive freighting into the back country calls for landing fields. These fields fall into two major classifications; class A for use by larger cargo-type planes, and class B for smaller light planes. Where heavy freight or crews of men are to be delivered, class A fields with level runways and clear approaches are necessary. Quick pick-up or delivery of one or two men and light equipment can be made on class B fields, which may be small cleared strips with one-way landing and take-off chances and sloping or undulating runways. Forest Service pilots must be good! In Oregon and Washington, tentative planning calls for class A fields at 12- to 20-mile intervals and class B strips as close as 6 to 10 miles. In most areas, however, rough topography will prevent attainment of this spacing. Where it is possible, it will bring men and supplies to within an hour's hike of practically any portion of most forests. Airfield development of this spacing would make it unnecessary to construct a large part of the planned road and trail systems on many national forests. Therefore, use of aircraft immediately becomes of interest to transportation planners.

Bringing back highly trained personnel, such as smoke jumpers, becomes a factor of increasing importance as their use expands. Quick return to base by air can double the effectiveness of a given squad during periods of high fire occurrence such as follow a series of lightning storms. Furthermore, in case of injury or sickness, it is difficult to measure the value of air transportation in saving lives and suffering.

Straight transportation of skilled personnel over long distances on the Western forests steps up the efficiency of overhead during the summer. In 1945 more than 1,000 trained fire-overhead were moved by airplanes to fire jobs. In one instance the Army Air Force moved 200 fire fighters 300 miles in a few hours.

In many places throughout the mountainous West, much valuable time may be lost in travel. On the Wallowa National Forest in Oregon, for instance, overhead and men leaving the Snake River Canyon must travel down the river to Lewiston, Idaho, and thence around to Enterprise, Oregon, by car to get back to headquarters—a distance of over 200 miles requiring almost 2 days' travel. This same trip can be made by air in less than an hour! Light planes with 2- or 3-passenger capacity are being used in many places like this in the Western regions for several months during the field seasons.

Four new, bright-red, four-place Stinson airplanes were purchased by the Forest Service for fire control use on the Western forests. They have been kept busy. When not in use by Fire Control, they have been in demand by the other divisions which pay a flat-rate charge for the service. The savings in cost to the renting parties have been amazing at times!

A new program is under way in Region 3, Arizona and New Mexico. When disastrous fires occurred on the Gila Wilderness Area during the early spring fire season, observers thought that smoke jumpers might have prevented considerable loss. Great altitude and the strong winds prevailing over the upland mesas have in the past discouraged smoke-jumper tests. Now, however, trials are proposed by a squad of jumpers and cargo droppers from one of the Northwest Regions. It is thought that new methods will be evolved or existing practices altered to fit the situation in the Southwest. Dovetailing the April to July fire season of the Southwest into that of the Northwest Regions may provide a longer period of training and usefulness for the present smoke-jumper program.

Helicopters for use by the Forest Service are still in the offing, but testing is going ahead as rapidly as possible. Present limits on useful load capacity, altitude range, and functional dependability, are being extended slowly by Army search and rescue units working out of March Field, Calif., in cooperation with the Forest Service. The R–5 model of the Sikorsky helicopter is the only one that has been tested, since the Army had the machines and the pilots to operate them. Other manufacturers are, however, entering the "direct lift" field, and it may not be too long before competition and increased demand for their specialized service will bring an "egg-beater" on the market which will fit Forest Service needs.

Bombing fires from the air has always kindled interested speculation by the general public. It has enthusiastic backers in the Army and the Forest Service. Army search and rescue units have a moderately successful record in the flat pine belt of Florida where water and chemical bombs were effective in slowing the progress of fires. Trials are to be continued during the summer of 1946 on an area in the high, rugged mountain country of the Lolo National Forest, in Montana. B–17 bombers, based at Great Falls, will drop special 165- and 300-gallon tanks on actual and test fires.

At this stage of program development, expert assistance is needed, Standards of practice and method must be established on a national basis if "foresters aloft" are to be efficient and effective. Fire Control has been fortunate in obtaining the part-time services of Don Hamilton, head of the Equipment Section of Engineering, who will act as aviation consultant for the Washington office and all Forest Service Regions. Mr. Hamilton, formerly a colonel in the Army Air Forces, has had wide experience in operating and maintaining aircraft of all types. During this summer he is traveling throughout the Western regions studying Forest Service aviation equipment and aerial operations.

The authors are well aware that the Federal Forest Service has not had a monopoly on the use of aircraft for forestry and fire fighting. Many State organizations and other Federal agencies have made wide use of planes for years. However, there has not been time to contact these organizations and gather information relative to their current programs. We have, therefore, confined our discussion to aviation as it concerned the Forest Service. Greater scope and range of protection afforded by a well-organized aerial service may lead eventually to a cooperative effort on the part of the various States and Federal agencies. It is expected that effective teamwork will result here as it has where activities have overlapped in the past.

The successful steps already taken in the use of aircraft in forest fire control work send thoughts flying ahead to search out other and practicable steps which undoubtedly lie in the future. Success in speeding men and supplies to fires opens new and exciting avenues of conjecture to the men who must plan for transportation and for recreational use of our forests. But for fire control planners it has passed the point of conjecture. Use of aircraft is an integral part of our job. "Force enough, fast enough" is now on the visible horizon.

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INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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